TD92TT"DETE8860

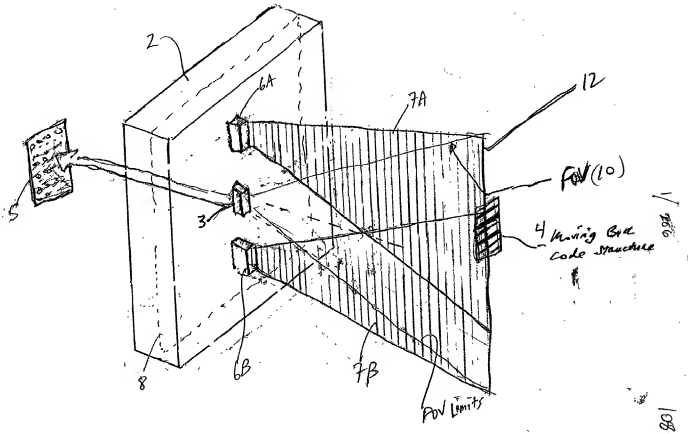

FIG 1A

108-109A/B/C/D

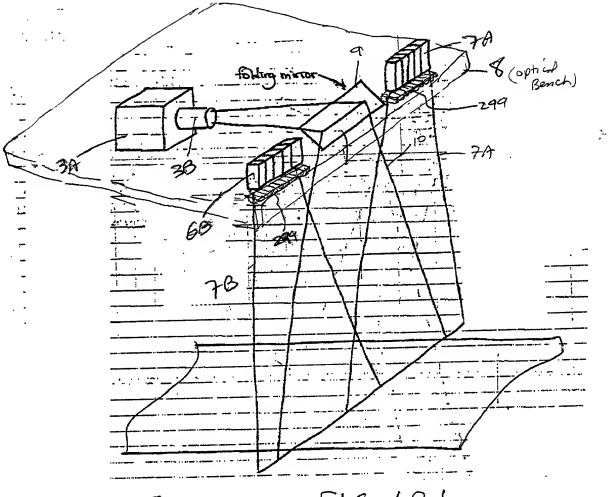
folding mirror
9
7A
8 (optical Bench)
299
12
7A
3A
3B
7
6B
299
7B
1A

FIG. 1B1

T092TT DETE8860

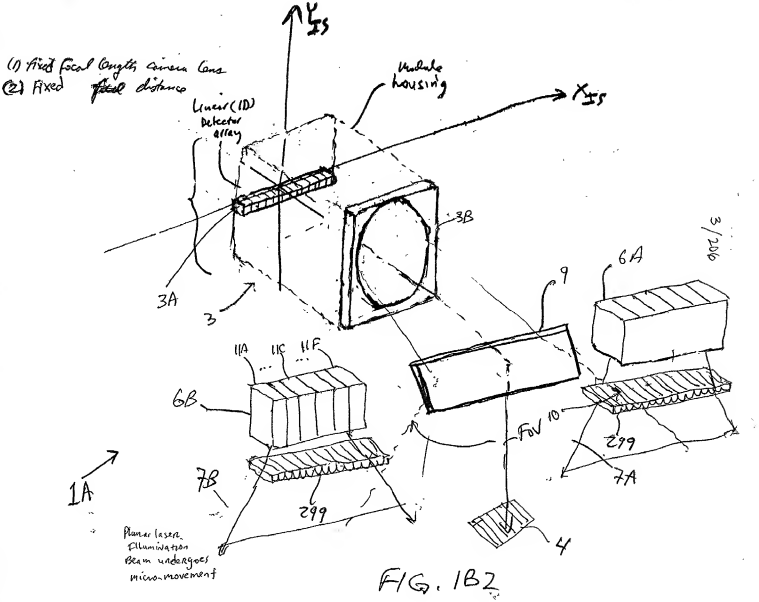

FIG. 1B2

3/206

TD92TT*0ETE8860

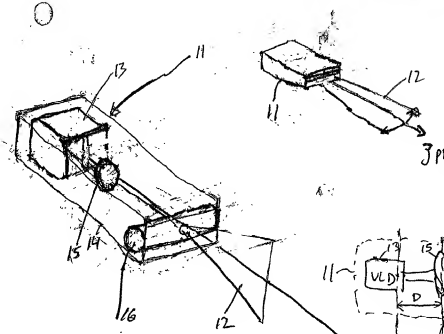

FIG. 1D

FIG. 1C

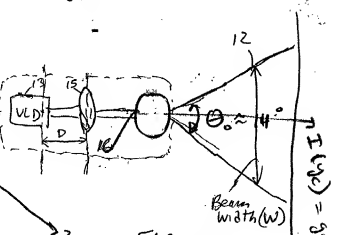

FIG. 1E1

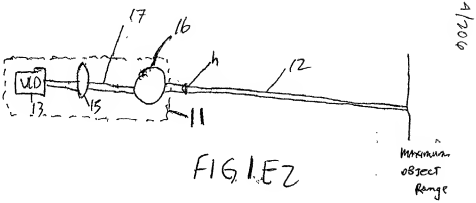

FIG. 1E2

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T092TT*0ET88860

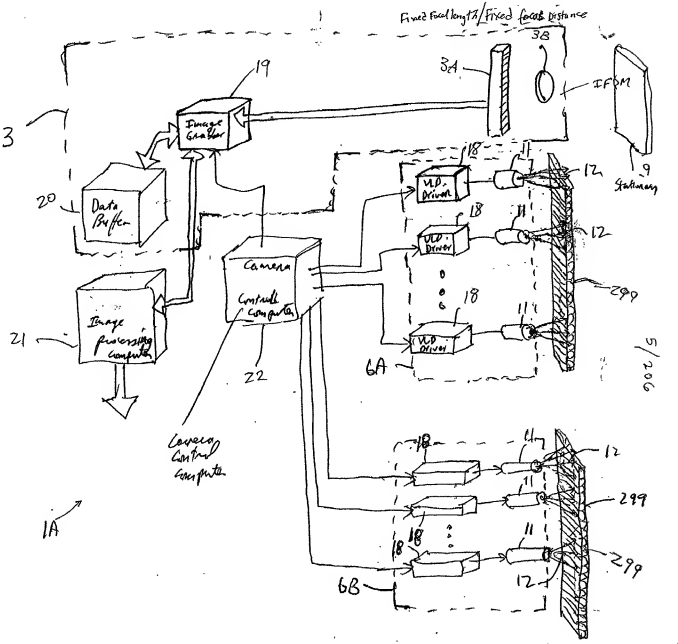


FIG. 1F

T0921T-DE2360

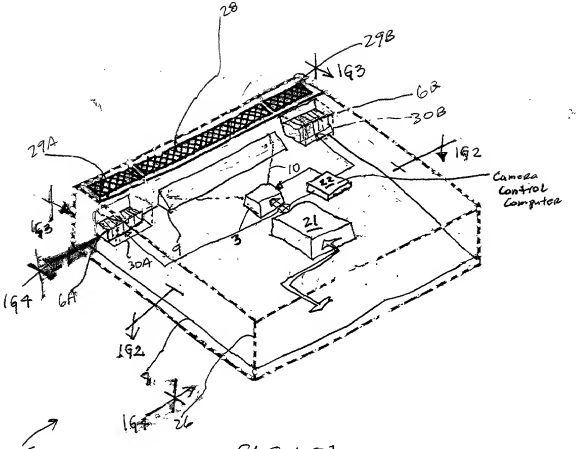


FIG 161

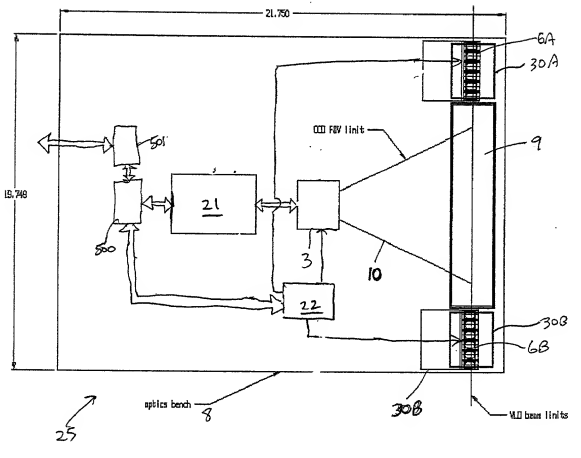

21.750
15.748
6A
30A
501
FOV limit
9
21
500
3
10
22
30B
6B
optics bench
8
25
30B
VLD beam limits

FIG. 16.2

T092TT'0ETE8860

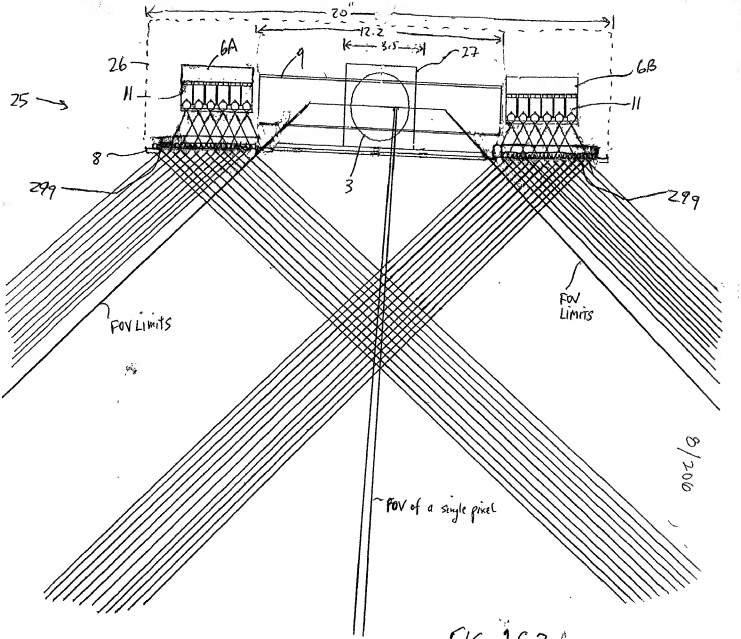


FIG 1G3

8/200

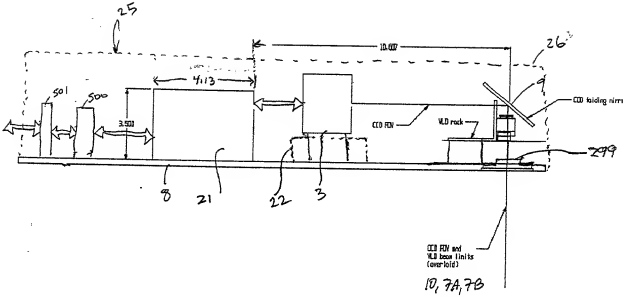
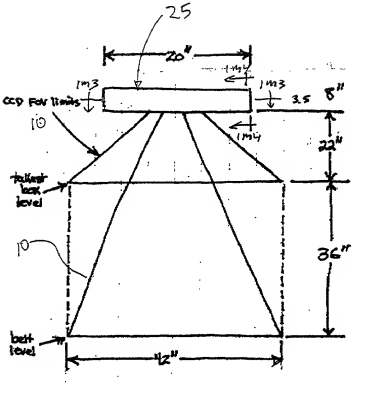

25
10.007
26
4.113
501
500
3.501
CCD FOV
VLD rack
CCD holding arm
279
8
21
22
3
CCD FOV and
VLD beam limits
(overlaid)
10, 74, 78

FIG. 164



* Fixed Field of Field

FIG. 165

TOSZTFOSTE3360

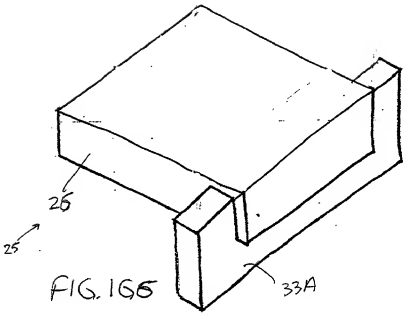


FIG. 16E

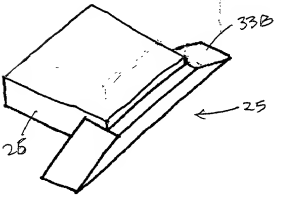


FIG. 16F

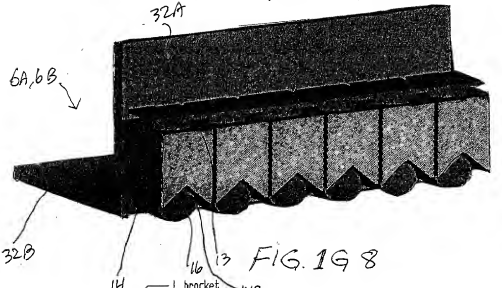


FIG. 1G 8

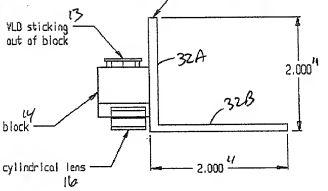


FIG. 1G. 9

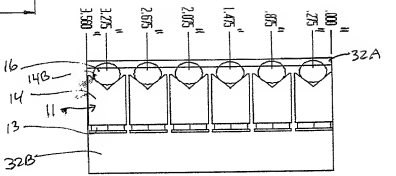


FIG. 1G10

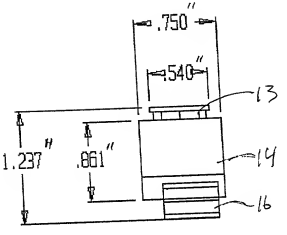


FIG. 16 11

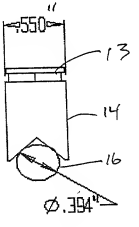


FIG. 16 12

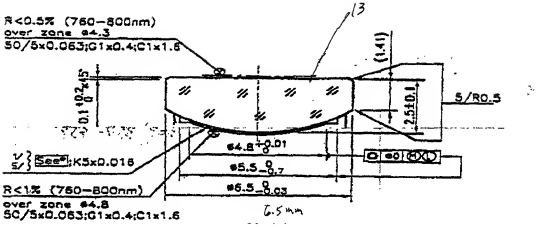


FIG. 1G 13

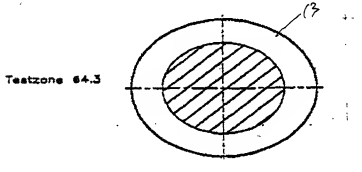


FIG. 1G 14

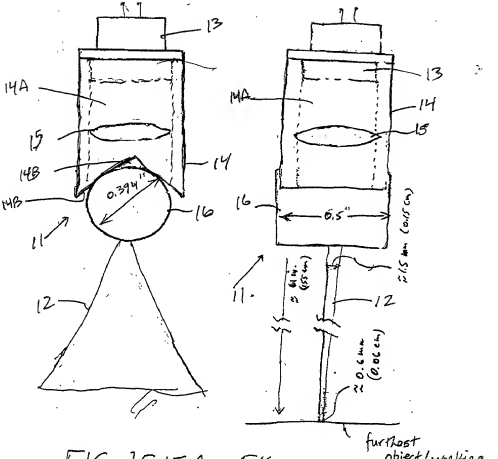


FIG. 1G15A FIG. 1G15B

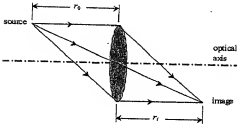


FIG. 1H1

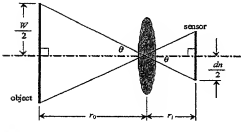


FIG. 1H2

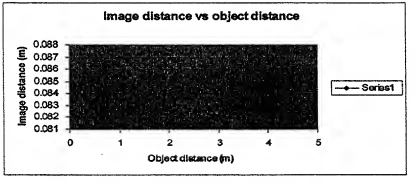


FIG. 1H3

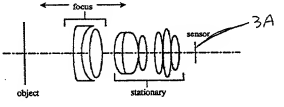


FIG. 1H4

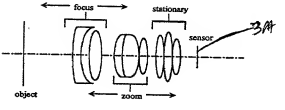
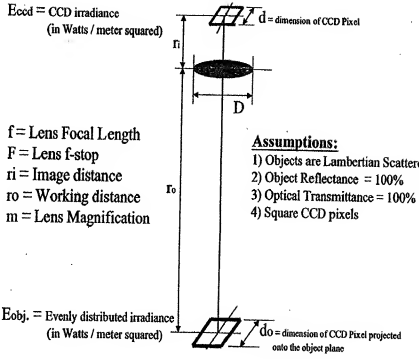


FIG. 1H5

T0927T7 "0ETE8850



CCD-Based Scanner

FIG. 1H6

10/201

T092TT'0ETE0860

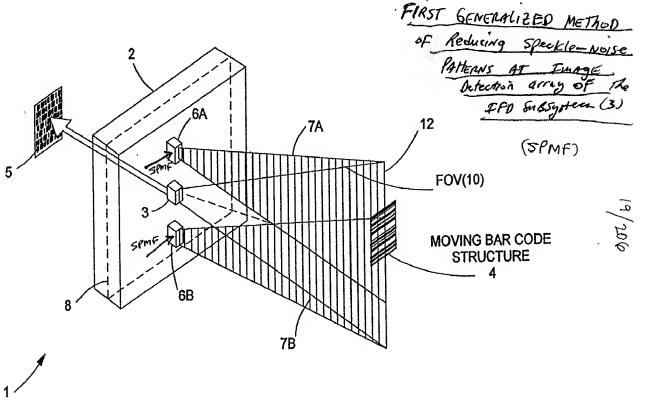


FIG. 1I1

TD9211 DE18B860

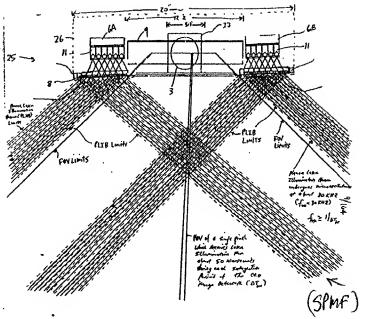


FIG. 11:2A

Prior to object illumination

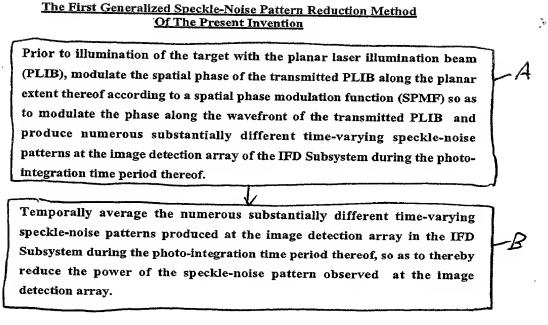

The First Generalized Speckle-Noise Pattern Reduction Method Of The Present Invention
Prior to illumination of the target with the planar laser illumination beam (PLIB), modulate the spatial phase of the transmitted PLIB along the planar extent thereof according to a spatial phase modulation function (SPMF) so as to modulate the phase along the wavefront of the transmitted PLIB and produce numerous substantially different time-varying speckle-noise patterns at the image detection array of the IFD Subsystem during the photo-integration time period thereof.
A
Temporally average the numerous substantially different time-varying speckle-noise patterns produced at the image detection array in the IFD Subsystem during the photo-integration time period thereof, so as to thereby reduce the power of the speckle-noise pattern observed at the image detection array.
B

FIG. 11B

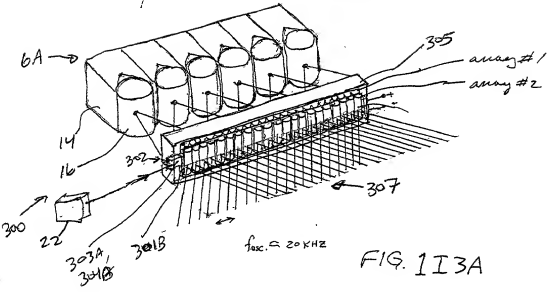


FIG. 1I3A

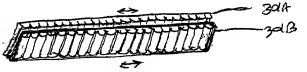


FIG. 1I3B

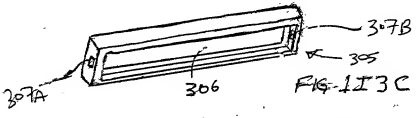


FIG. 1I3C

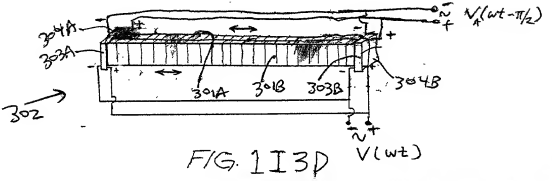


FIG. 1I3D

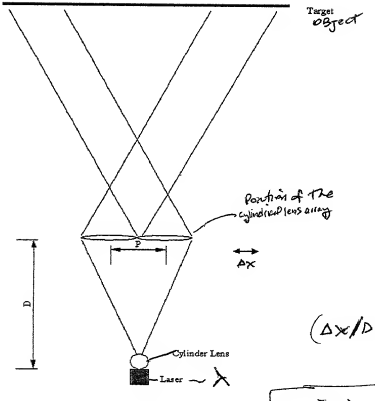


Figure 1

FIG. 1I3E

RECTIFIED SHEET (RULE 91)

FIG. 1I3F

FIG 1I3G

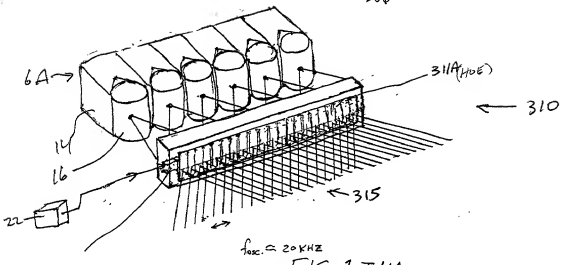


FIG 1I4A

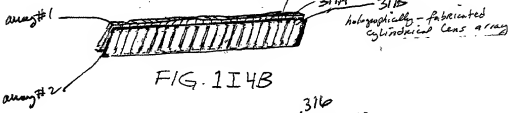


FIG. 1I4B

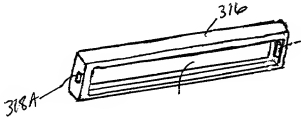


FIG 1I4C

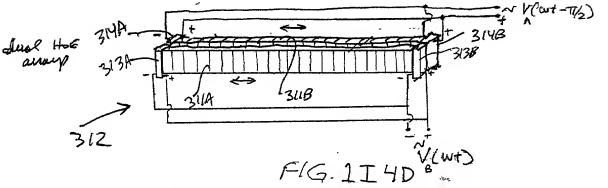


FIG. 1I4D

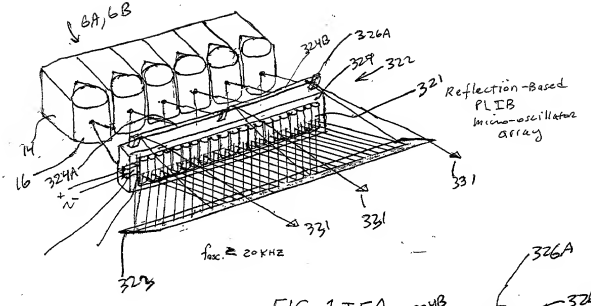


FIG. 1I5A

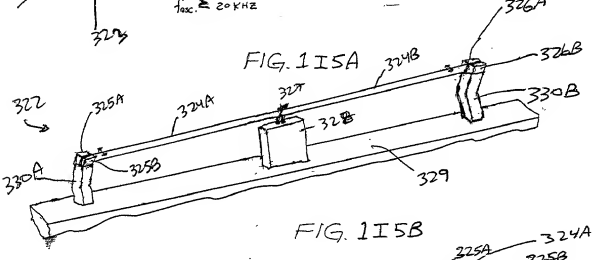


FIG. 1I5B

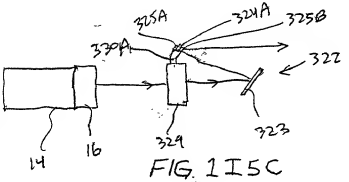


FIG. 1I5C

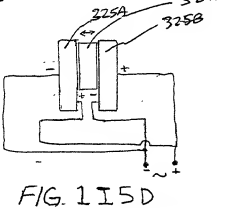


FIG. 1I5D

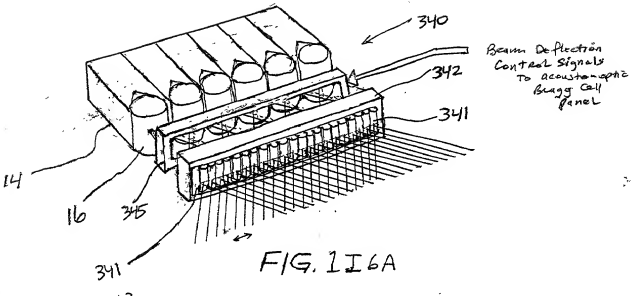


FIG. 11 6A

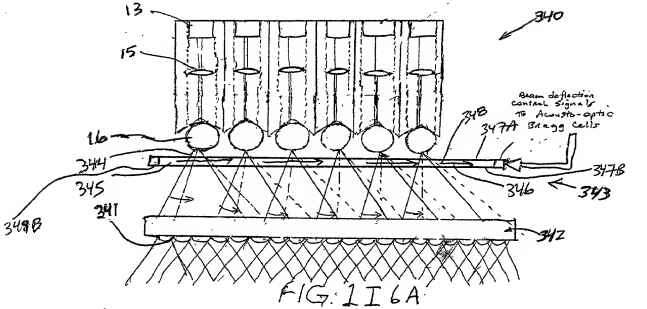


FIG. 11 6A

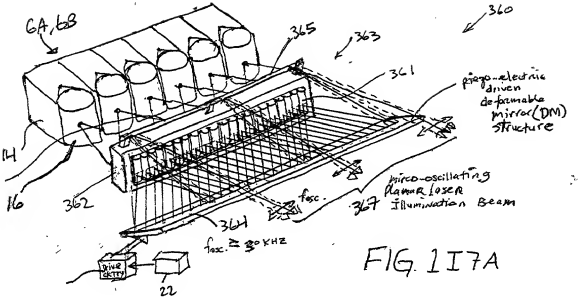


FIG. 1I7A

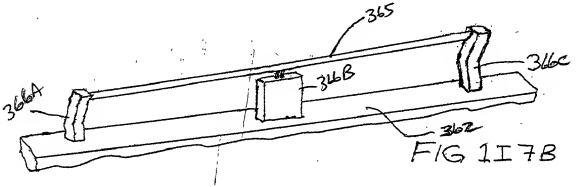


FIG 1I7B

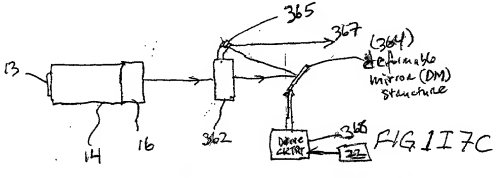


FIG 1I7C

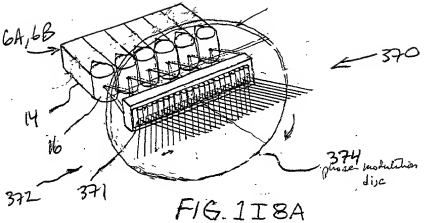


FIG. 1I8A

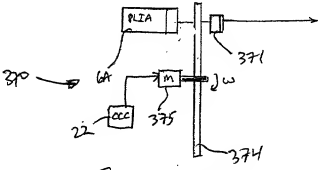


FIG. 1I8B

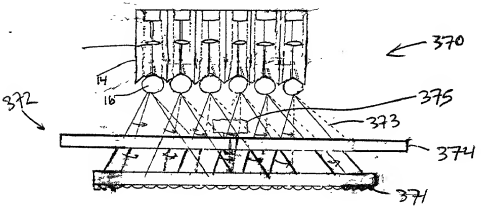


FIG. 1I8C

TD9211 DETE8860

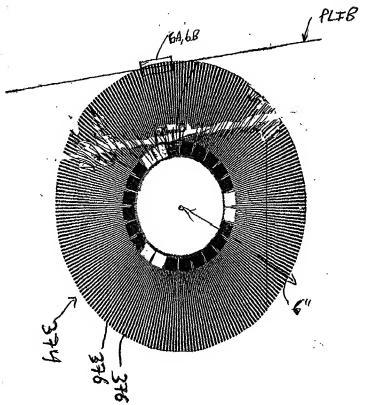


FIG 1I8D

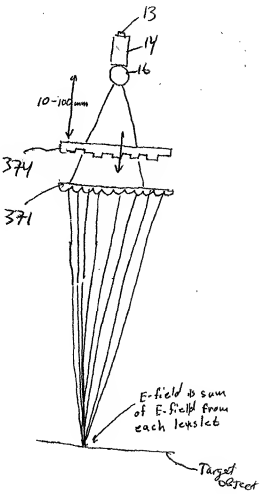


FIG 1I8E

30/2010

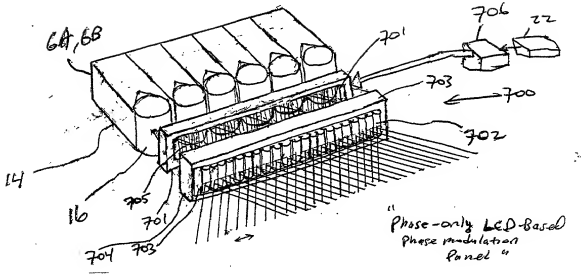


FIG.1I8F

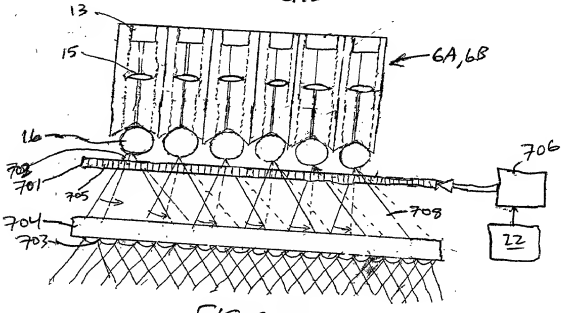


FIG.1I6

TD92TT'0ETE8860

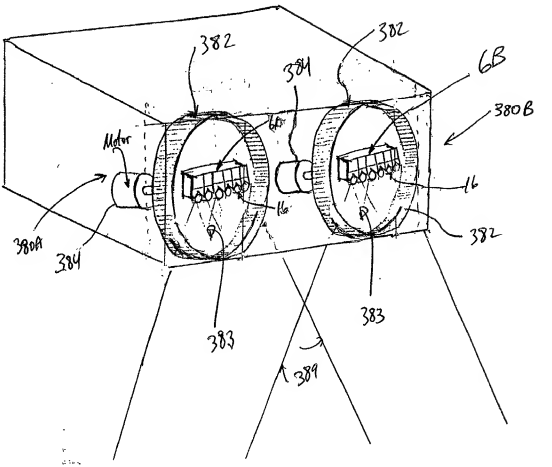


FIG. 1I 9A

3/2/06

TD92TT*DE7E8860

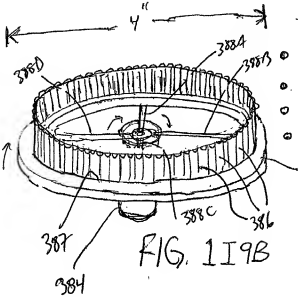


FIG. 11 9B

optical specifications:

- 30 cylindrical lens (lenses) per linear inch
- focal length ≈ 2.0 millimeters
- diameter of lenticular carousel ≈ 4 inches
- acrylic material
- lenticular cylindrical elements on inside diameter

33/200

09883130.111601

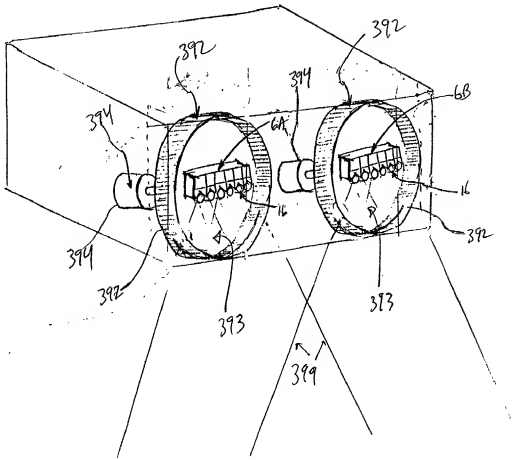


FIG. 11 10A

TD92TT'0ETE8860

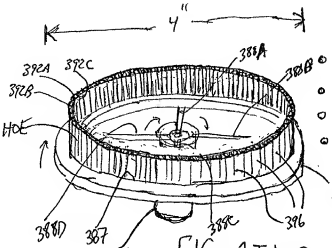


FIG. 1I10B

optical specifications:

- 30 cylindrical lens (lines) per linear inch
- focal length: 2.0 millimeters
- diameter of lenticular carousel ≈ 4 inches
- acrylic material
  - lenticular cylindrical elements on inside diameter

TD92TT'0ETE8860

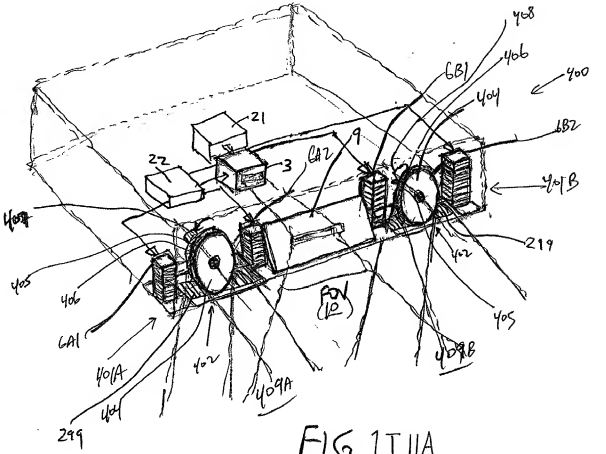


FIG. 1I11A

09823130.112501

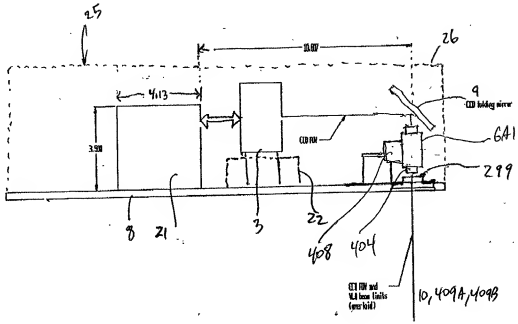


FIG 1I11B

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09883130.112601

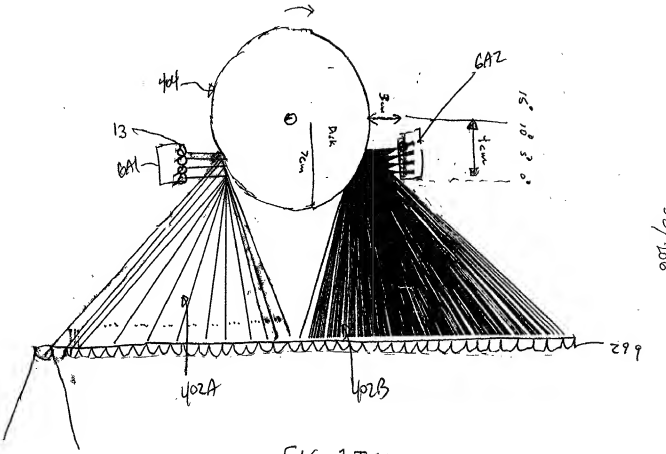

FIG. 1I11C

5092115 DETE8860

Second Generalized Method of Reducing Speckle-Noise Patterns at Image Detection Array of the IFD Subsystem (3)

(TIMF)

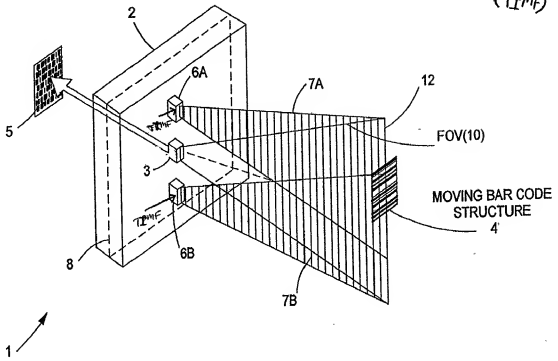

FIG. 1 I 12

3/9/2006

PCT/US2018/063869

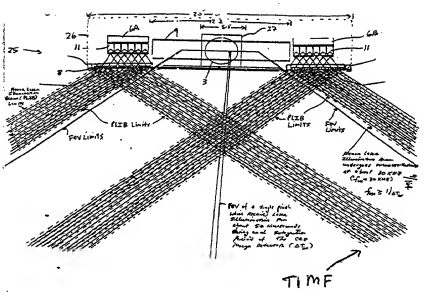

FIG. 1I 13A

SUBSTITUTE SHEET (RULE 26)

The Second Generalized Speckle-Noise Pattern Reduction Method Of The Present Invention

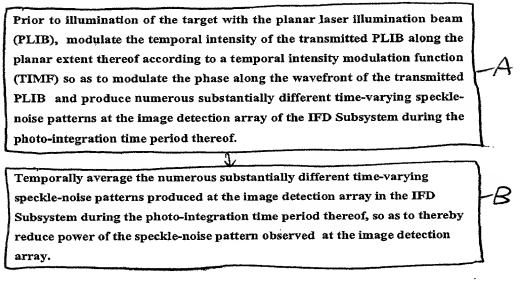

FIG. 11I3B

FOSTER-WEEBER

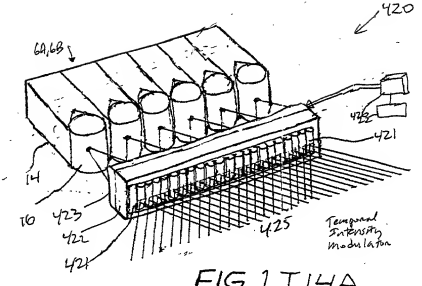

FIG. 1I14A

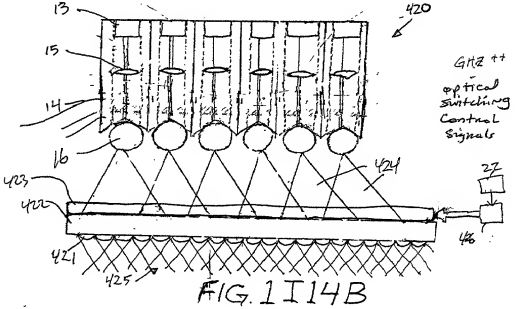

FIG. 1I14B

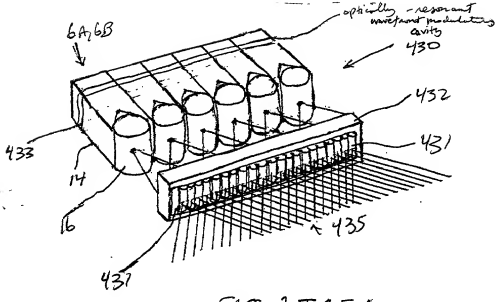

FIG. 1I15A

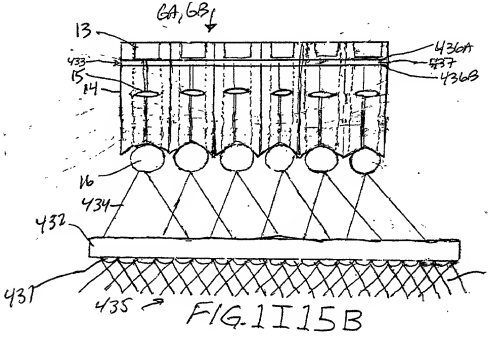

FIG. 1I15B

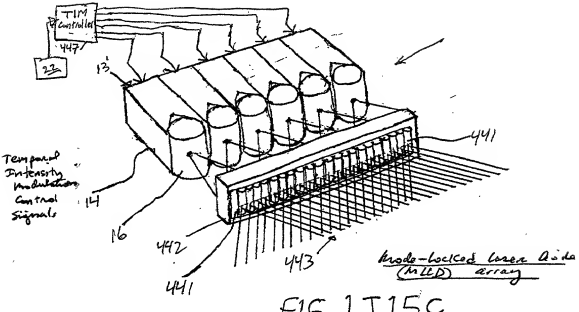

FIG. 1I15C

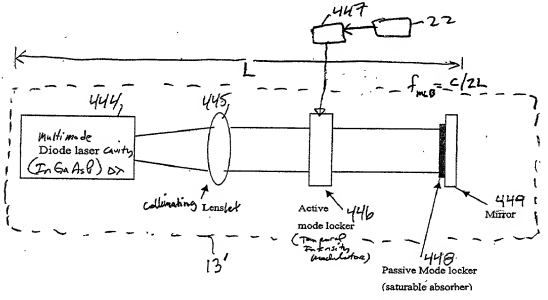

FIG. 1I15D

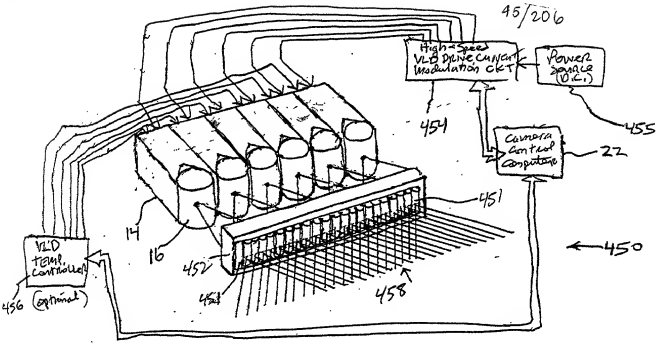

FIG. 1I16A

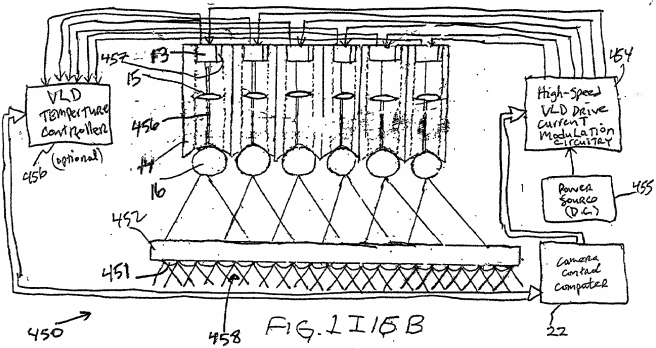

FIG. 1I16B

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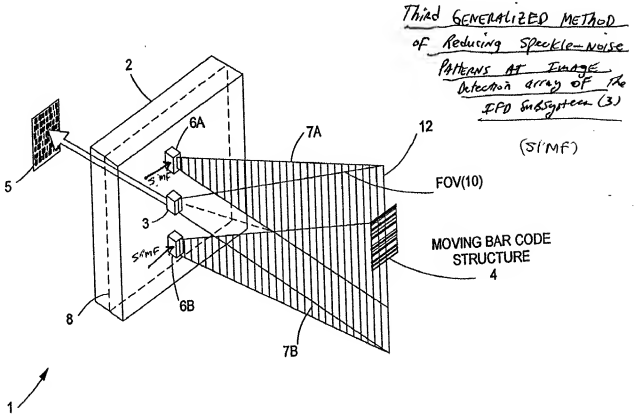
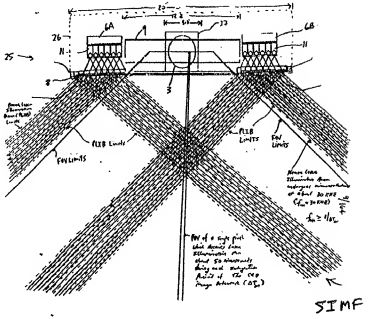


FIG 17

09883430 '112501



Relative to object illumination

FIG. 1I 18A

The Third Generalized Speckle-Noise Pattern Reduction Method Of The Present Invention

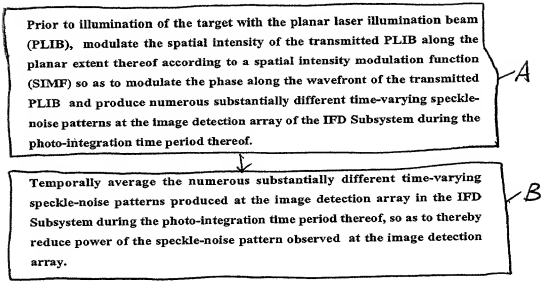


FIG. 1I18B

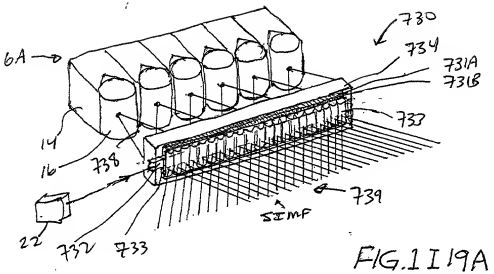


FIG. 1I19A

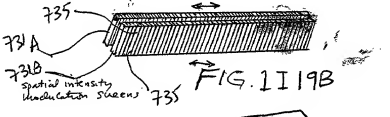


FIG. 1I19B

FIG. 1I19C

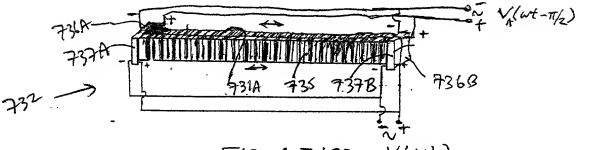


FIG. 1I19D

T092TT*DETE8860

Fourth Generalized Method of Reducing Speckle-Noise Patterns at Image Detection Array of the IFD Subsystem

(SIMF)

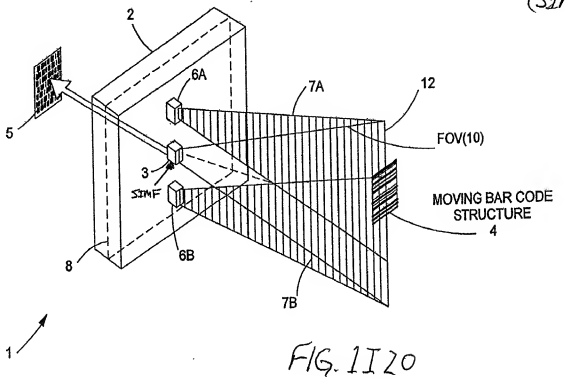


FIG. 11.20

Applicant's Exhibit

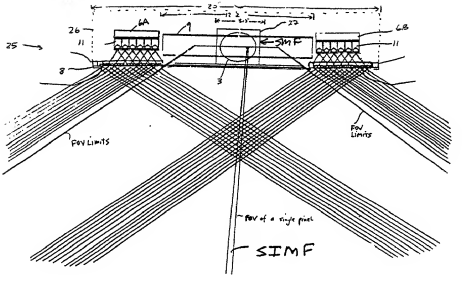


FIG. II 21A

The ~~Fourth~~ Generalized Speckle-Noise Pattern Reduction Method Of The Present Invention

A — After illumination of the target with the planar laser illumination beam (PLIB), modulate the spatial intensity of the reflected/scattered (i.e. received) PLIB along the planar extent thereof according to a spatial intensity modulation function (SIMF) so as to modulate the phase along the wavefront of the received PLIB and produce numerous substantially different time-varying speckle-noise patterns at the image detection array of the IFD Subsystem during the photo-integration time period thereof.

B — Temporally average the many substantially different time-varying speckle-noise patterns produced at the image detection array in the IFD Subsystem during the photo-integration time period thereof, so as to thereby reduce the speckle-noise pattern observed at the image detection array.

FIG. 11 21B

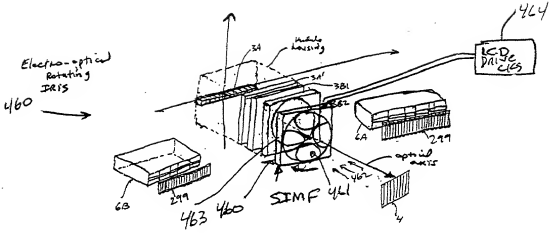


FIG. 1I 22A

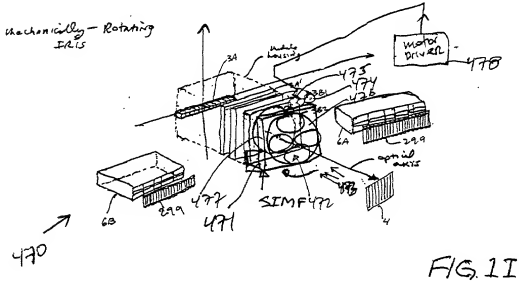


FIG. 1I 22B

T092TT*DETE886D

Fourth Generalized Method of Reducing Speckle-Noise Patterns at Image Detection Array of the IFD Subsystem

(TIMF)

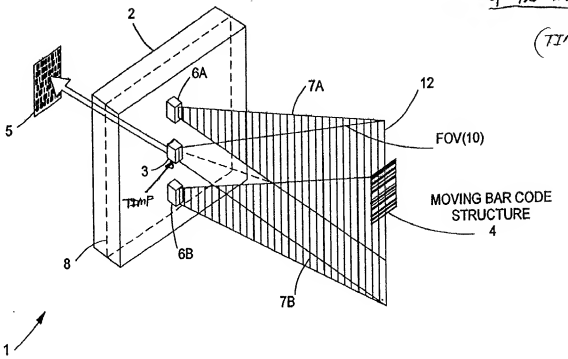


FIG.1I23

T09211 05138861

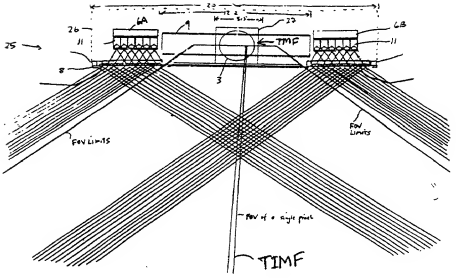


FIG. 1I 24A

The Fifth Generalized Speckle-Noise Pattern Reduction Method Of The Present Invention

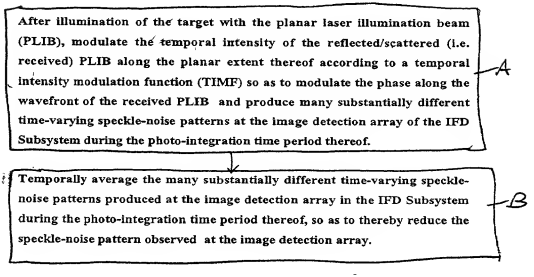


FIG. 11 24B

T092TT'0ETE886D

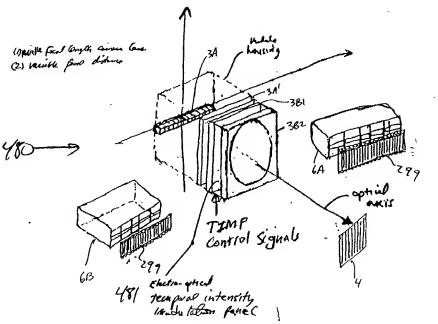


FIG 1I 25

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Fixed focal length lens cases

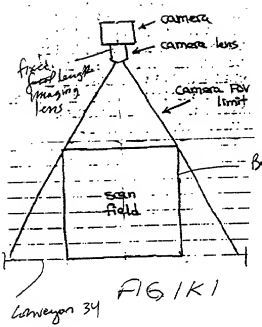

FIG 1K1

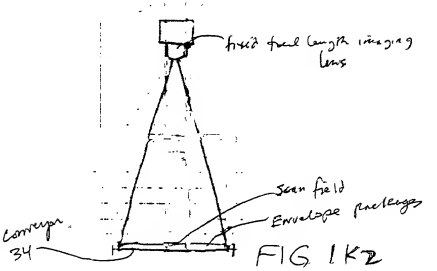

FIG 1K2

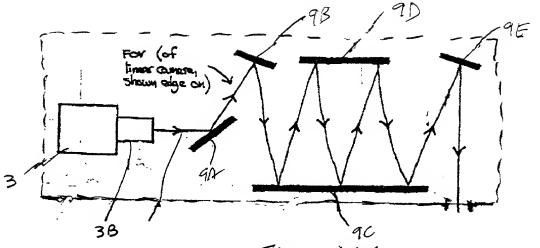

FIG. 1L1

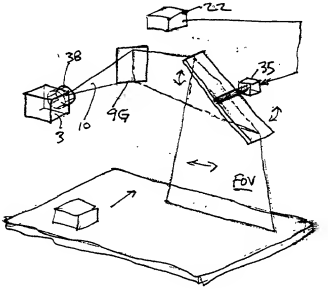

FIG 1L2

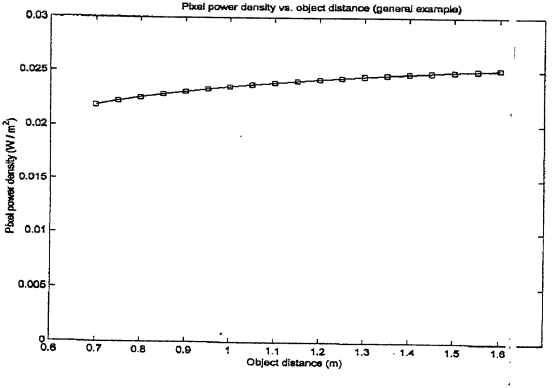
Pixel power density vs. object distance (general example)
Pixel power density (W / m²)
0.03
0.025
0.02
0.015
0.01
0.005
0
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
1.6
Object distance (m)

FIG. 1M1

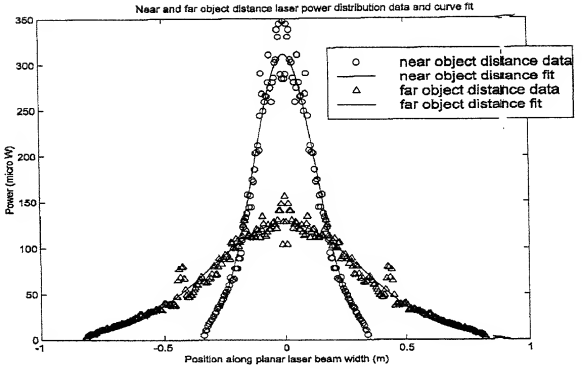
Near and far object distance laser power distribution data and curve fit
near object distance data
near object distance fit
far object distance data
far object distance fit
Power (micro W)
Position along planar laser beam width (m)
350
300
250
200
150
100
50
0
-1
-0.5
0
0.5
1

FIG. 1M2

FORGET-DETECTED

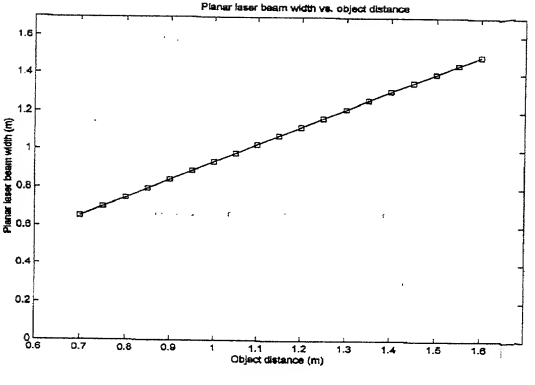

FIG. 1M3

SUBSTITUTE SHEET (RULE 26)

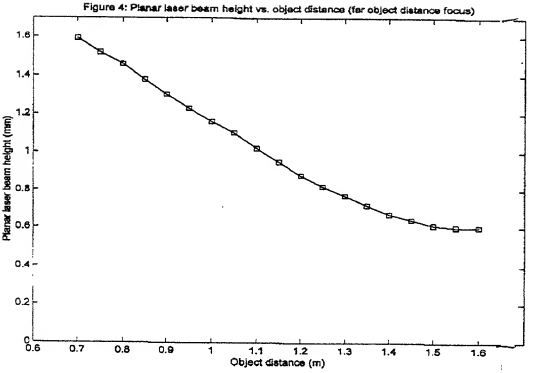

FIG. 14

SUBSTITUTE SHEET (RULE 26)

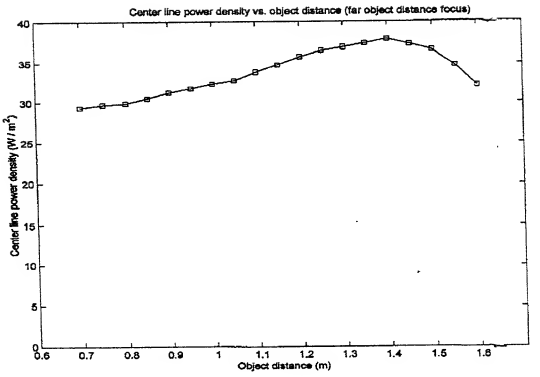

FIG. 1N

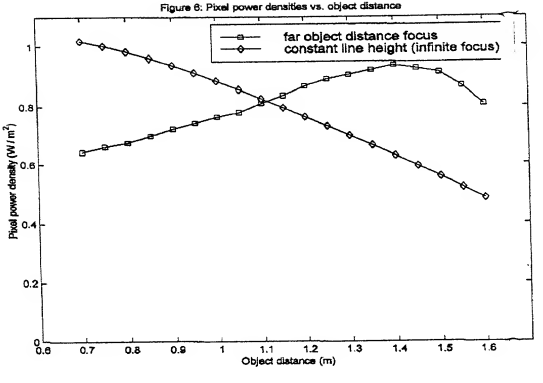
Figure 6: Pixel power densities vs. object distance
far object distance focus
constant line height (infinite focus)
Pixel power density (W/m²)
Object distance (m)
0
0.2
0.4
0.6
0.8
1
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
1.6

FIG. 10

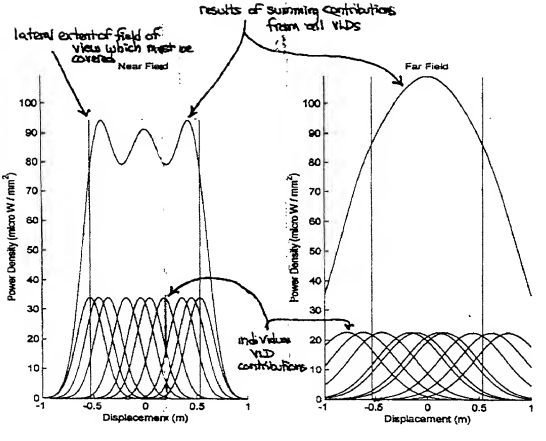

FIG 1P1

FIG 1P2

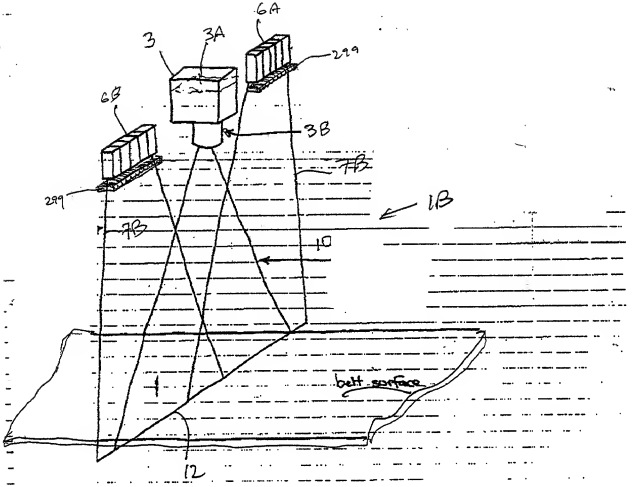

FIG. 1Q1

T09211 DET88860

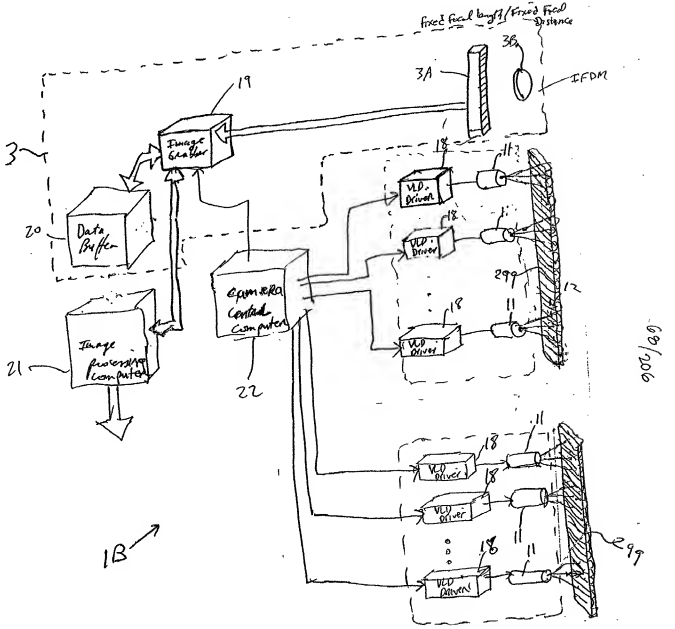

FIG. 1Q2

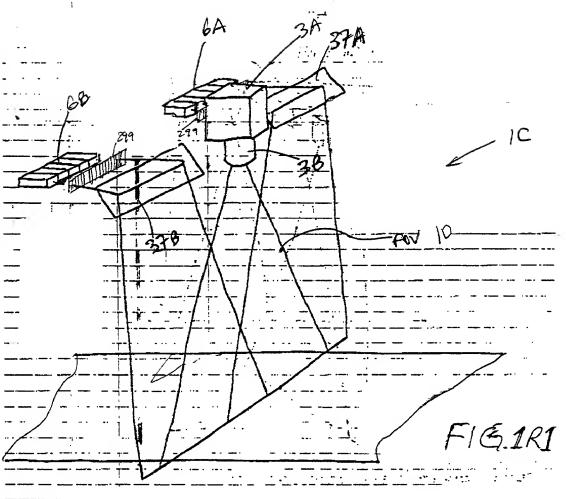

FIG.1R1

T092TT'0E1E8860

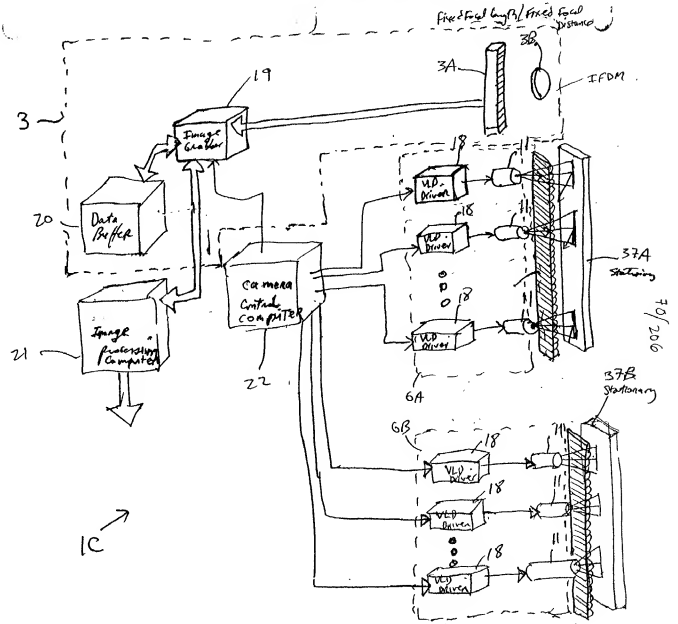

FIG 1R2

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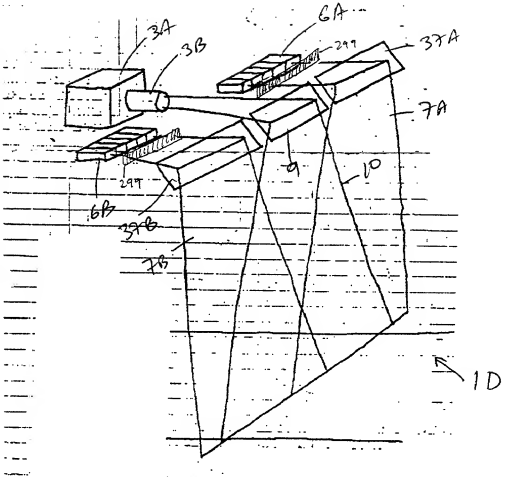

FIG. 1S1

TD9211 08888830

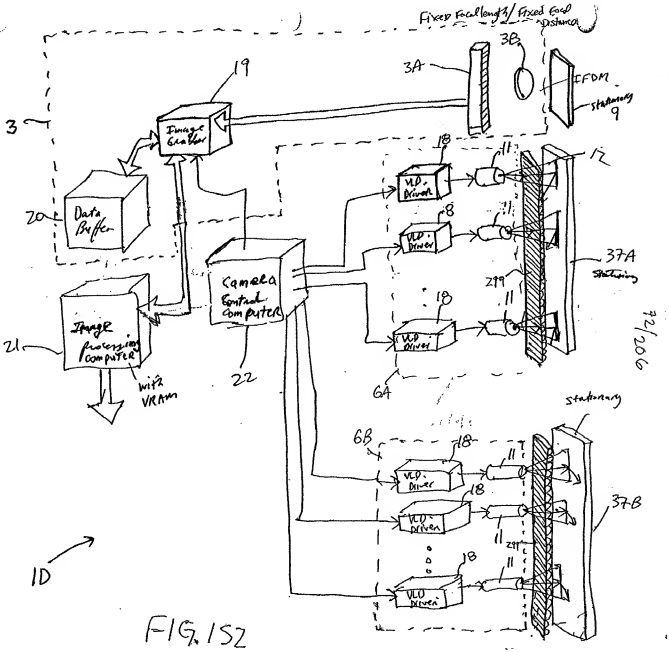

FIG. 152

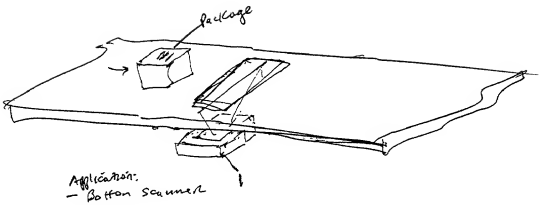

FIG. 1T

D0882130.112601

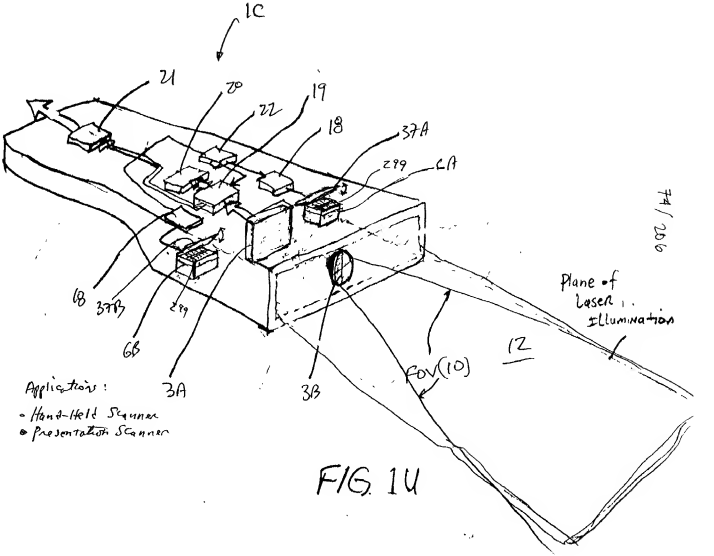

FIG. 1A

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T092TT'0ETZ8060

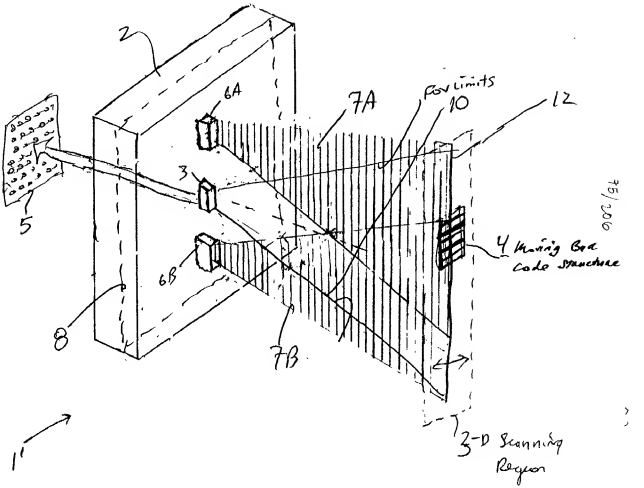


FIG. IVI

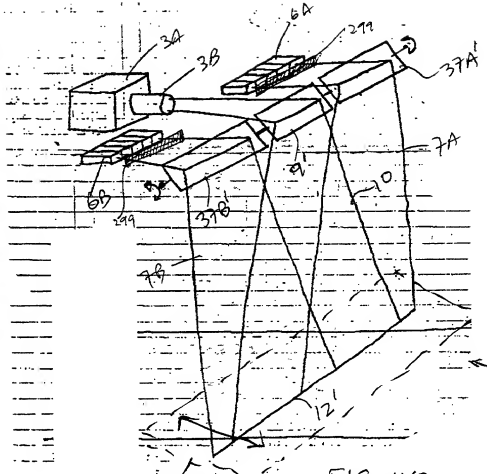


FIG. 1V2

T092TT "DETE8860

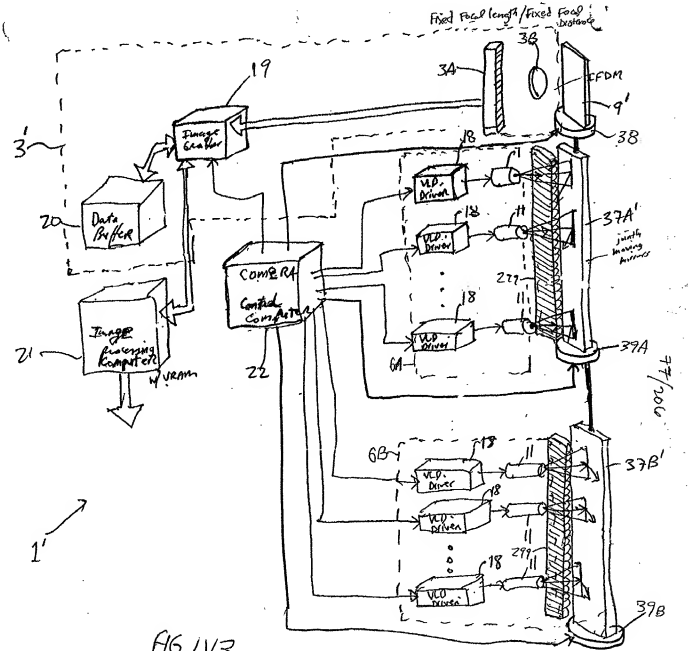


FIG. 1V3

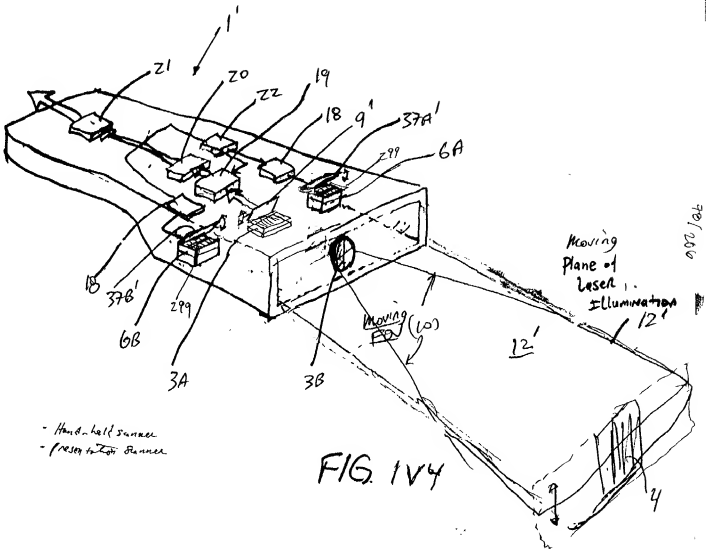
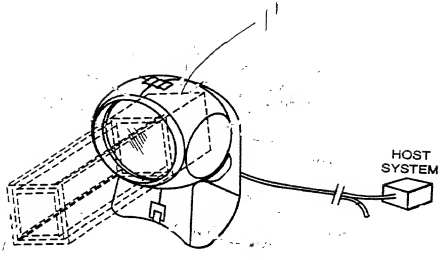

1'
21
20
22
19
18
9'
37A'
6A
299
10
37B'
299
6B
3A
3B
Moving
(10)
12'
Moving
Plane of
Laser
Illumination
12'
4
- Hand-held Scanner
- Fixed-Mount Scanner

FIG. 1V4

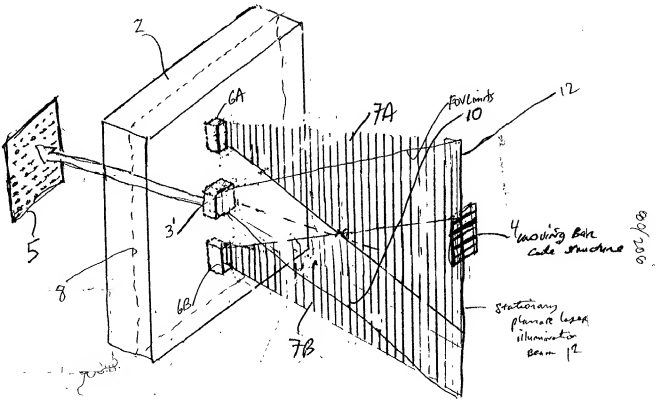
4,653,114 4,736,436 4,794,239 5,073,958



(Presentation type scanner)

FIG. 1V5

TD92TT*0ETE0860



40

FIG. 2A

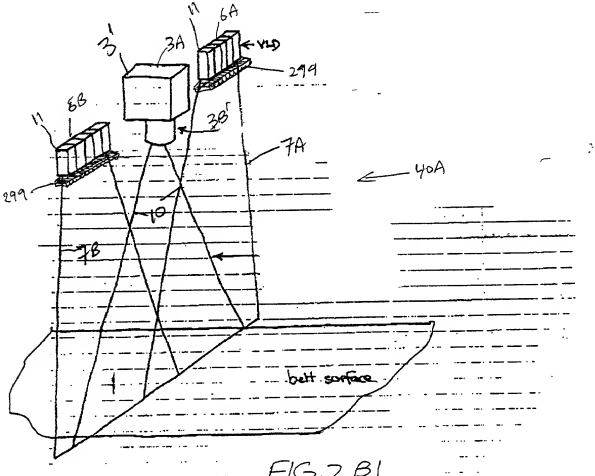


FIG. 2B1

TD92TT" DETE8860

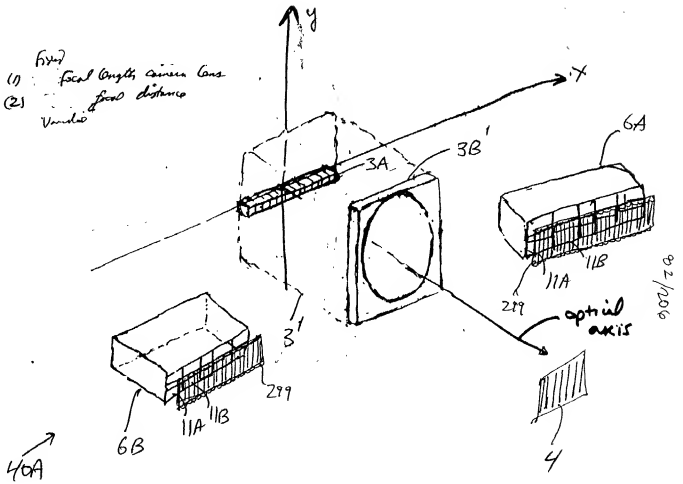


FIG. 2B2

T092TT' DETE8860

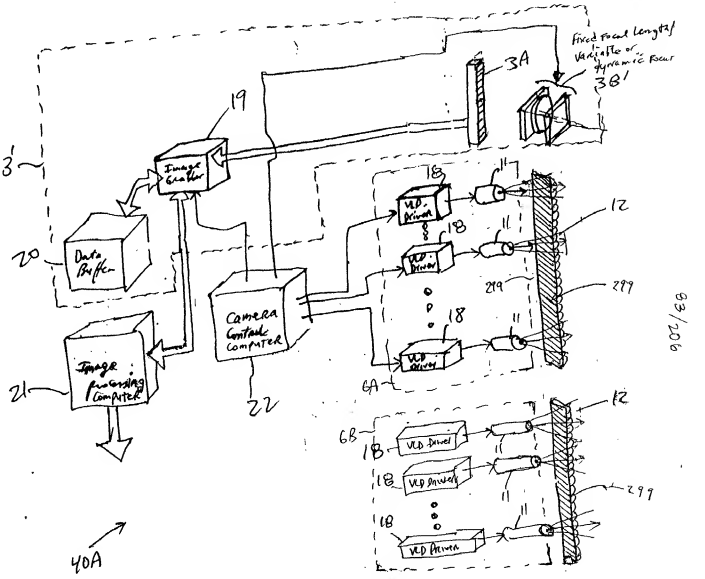


FIG. 2C1

TO9211 "0E1E8860

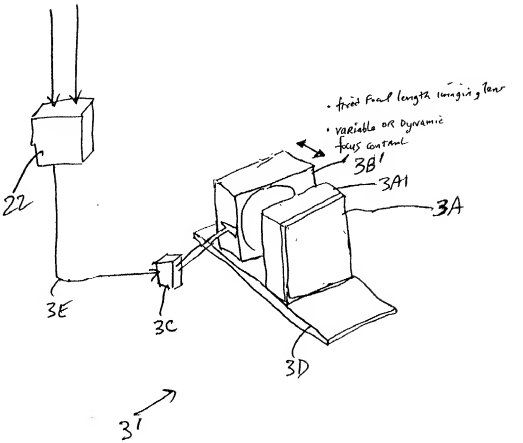


FIG. 2C2

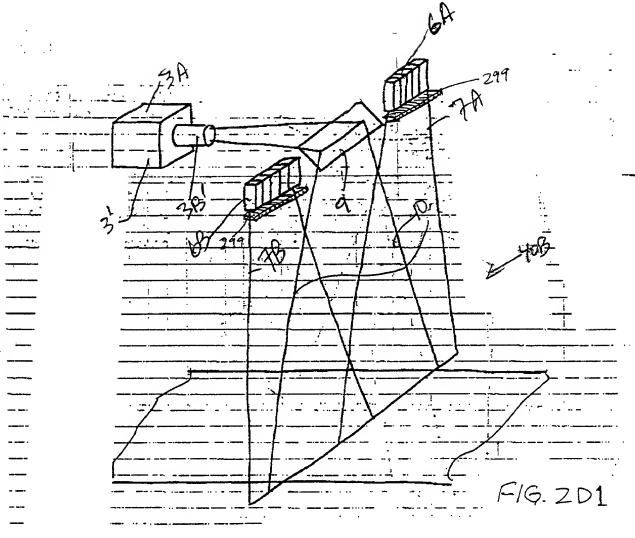


FIG. 2D1

T092TT'0ETE886D

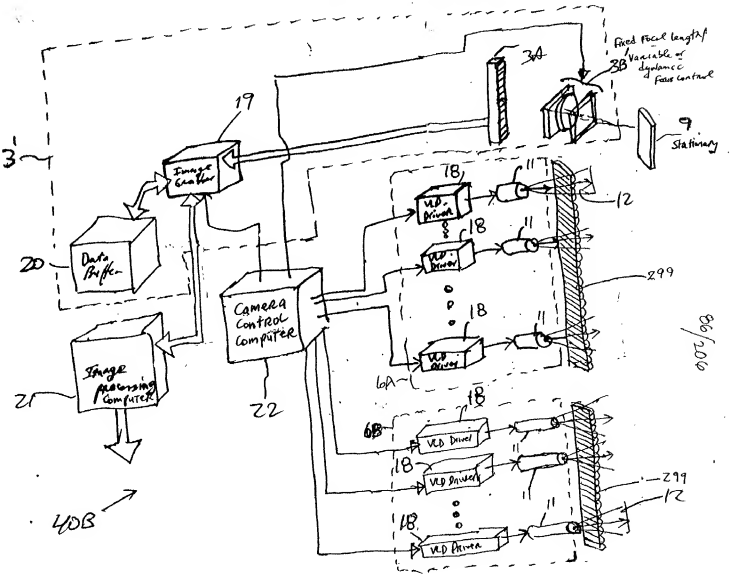


FIG. 2D2

TD92TT'0ETE8B6D

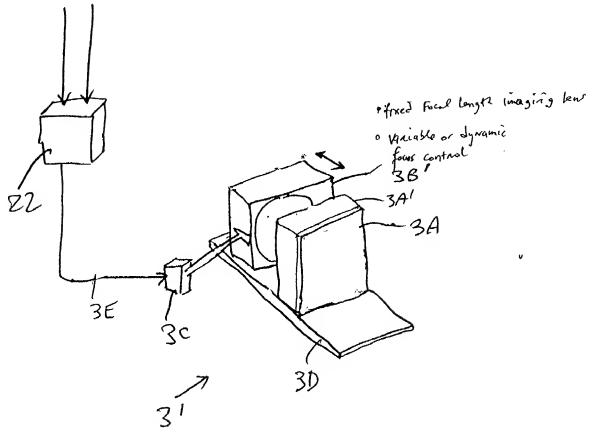


FIG. 2D3

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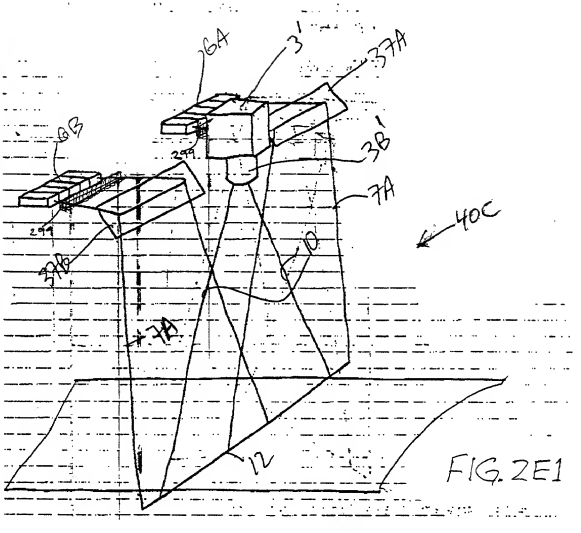

FIG. 2E1

T092TT'DETE886D

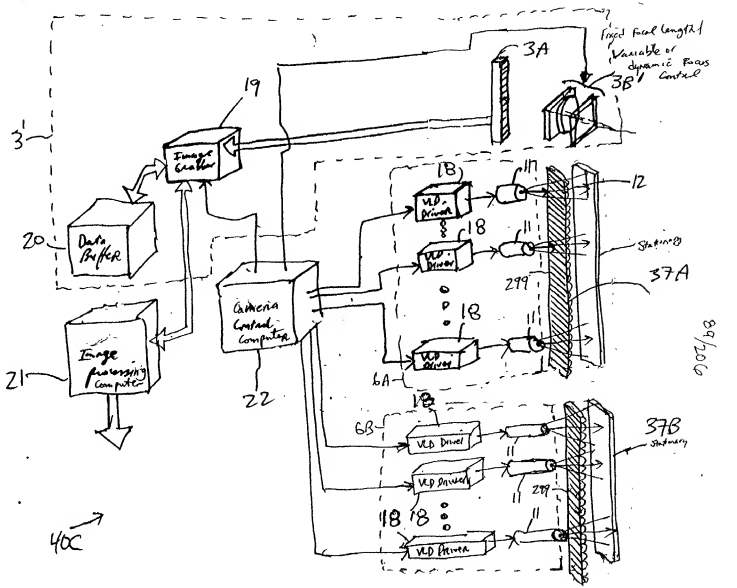

FIG. 2E2

09883130 .112604

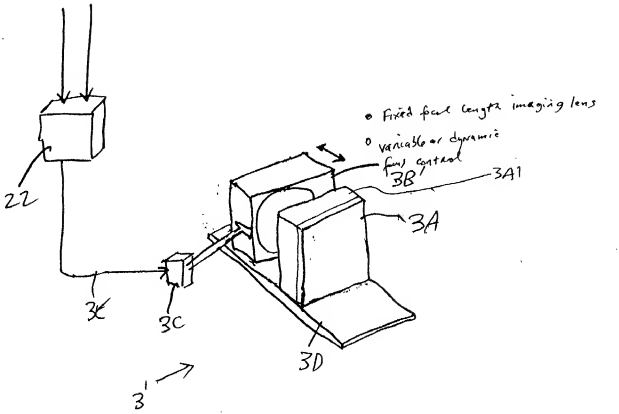

FIG. 2E3

09/883,130

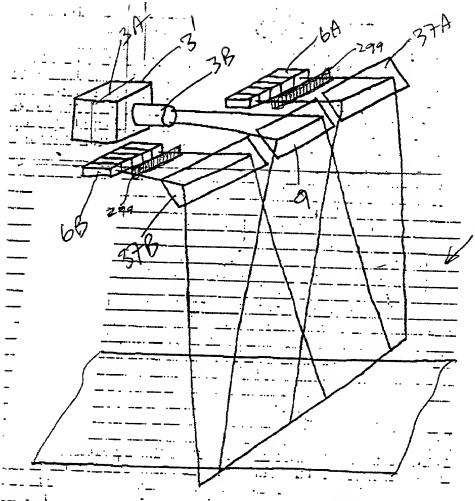

FIG. 2F1

T0527T*0ETE8860

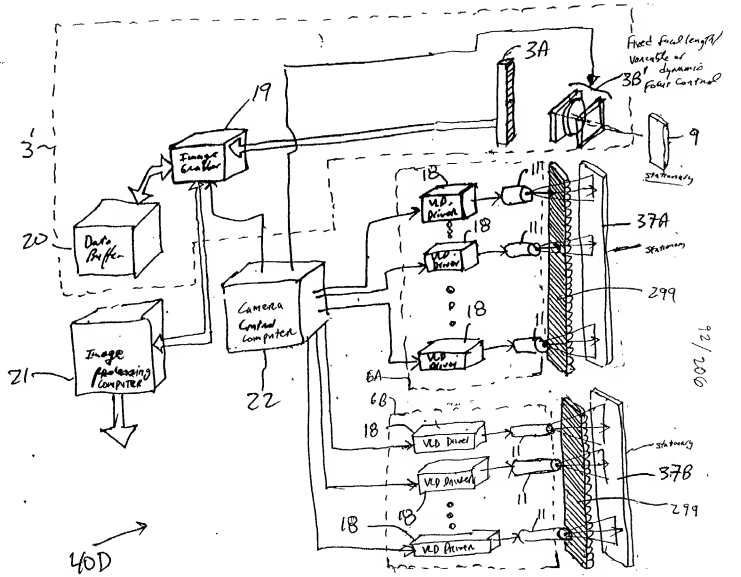

FIG 2F2

T092TT'DETE8060

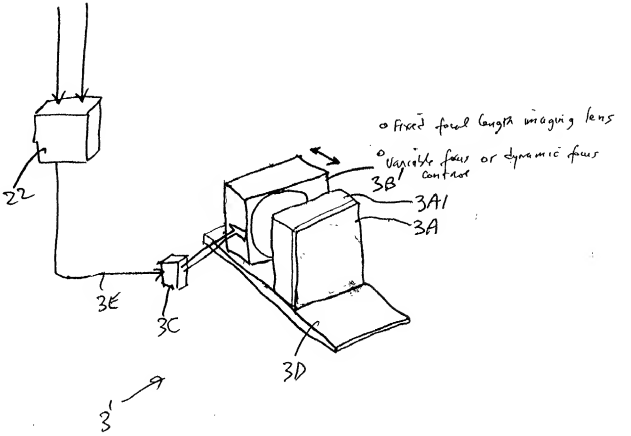

FIG. 2F3

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PCT/US2015/036810

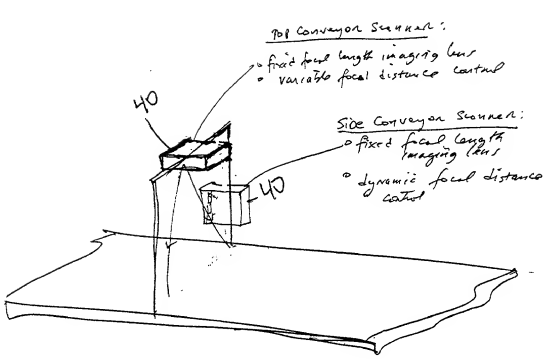

FIG. 2G

T092TT"DETE8960

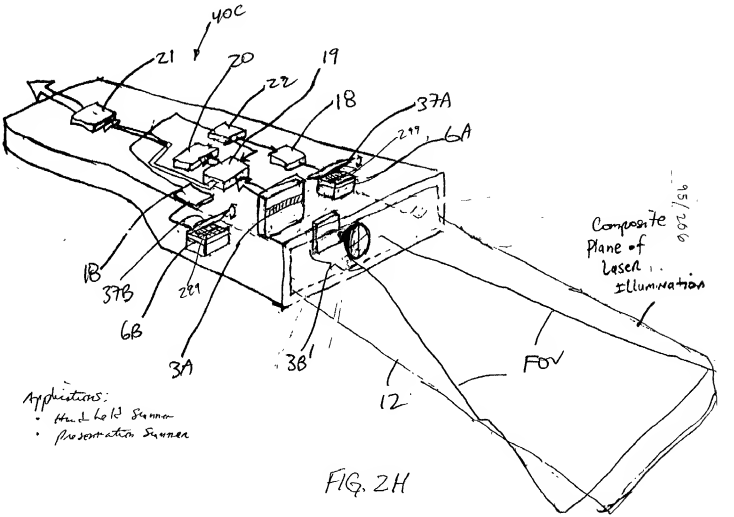

FIG. 2H

TD92TT*DETE8860

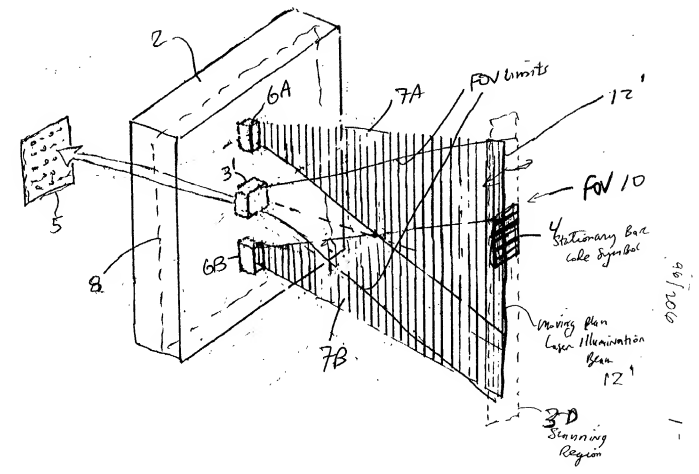

FIG. 2I

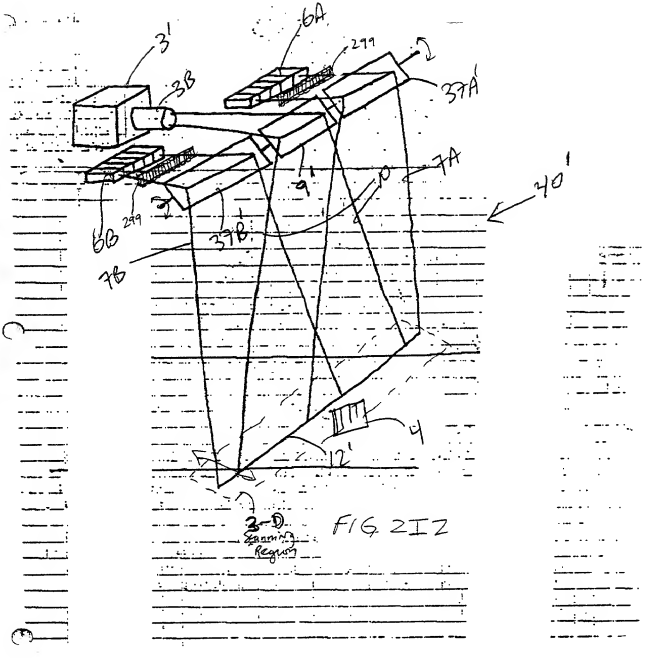

FIG 2I2

TD92TT"OETE8860

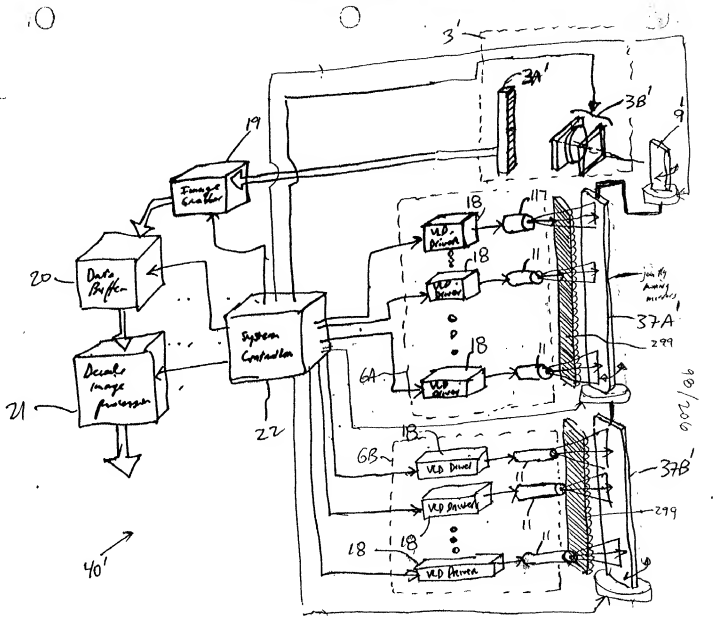

FIG. 2I3

TD92TT"DETE8860

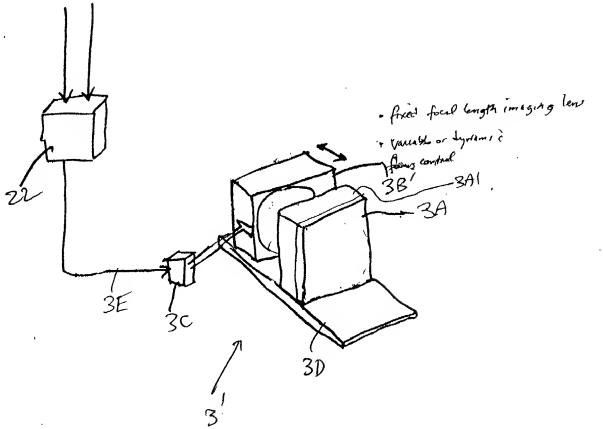

FIG. 2I4

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T092TT'0ETE8860

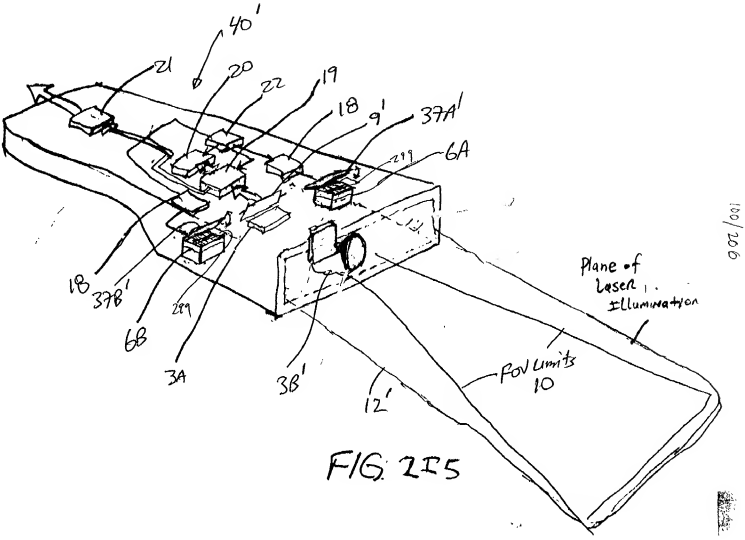

FIG. 2E5

100/200

RECEIVED

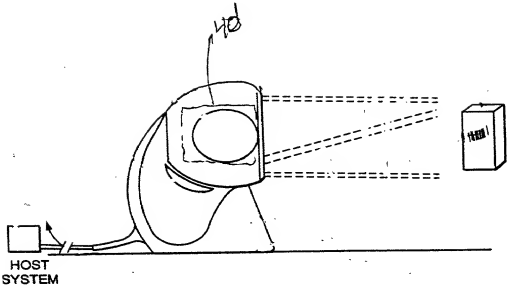

FIG. 2I6

09083130 "11260T

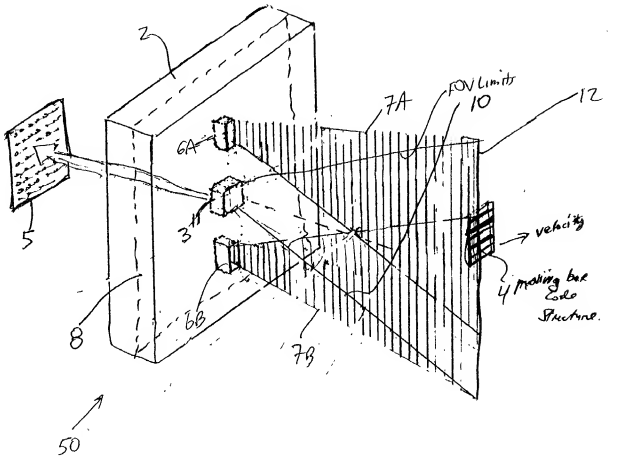

FIG 3A

10/21/06

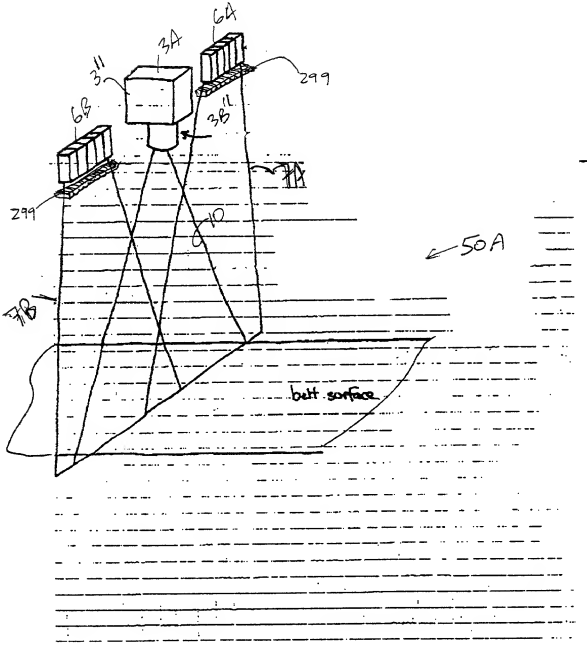

FIG. 3B1

T092TT'DETE8860

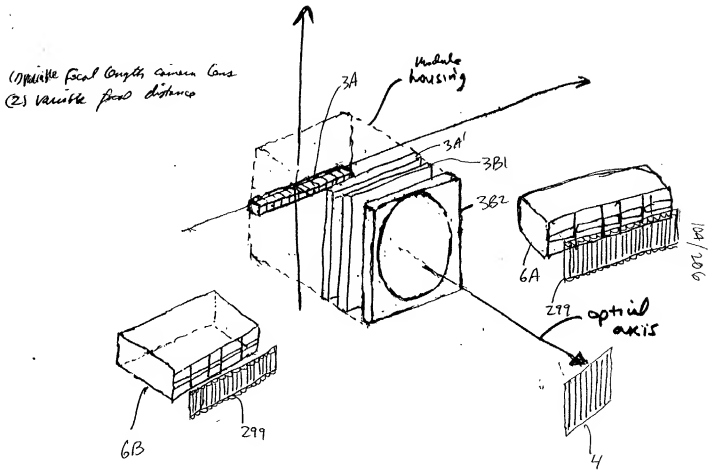

FIG 3B2

T092TT' DETE8B6D

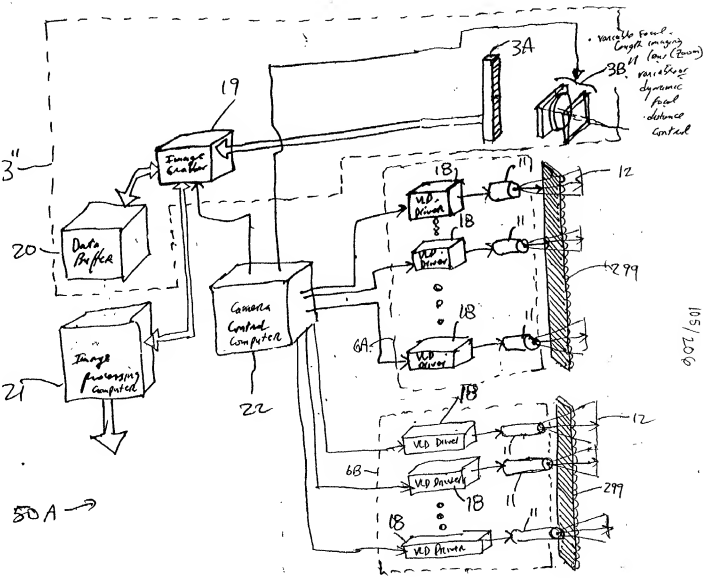

FIG 3C1

T092TT'DETE886D

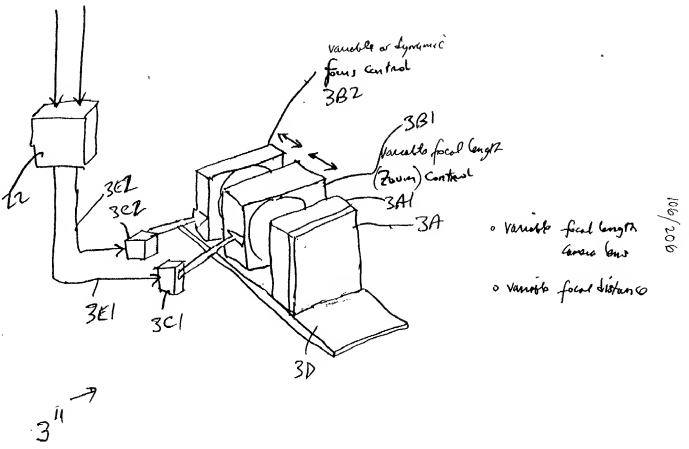

FIG. 3C2

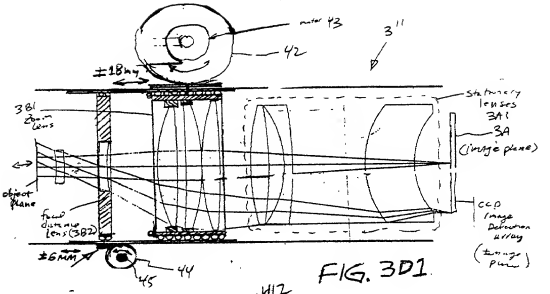

FIG. 3D1

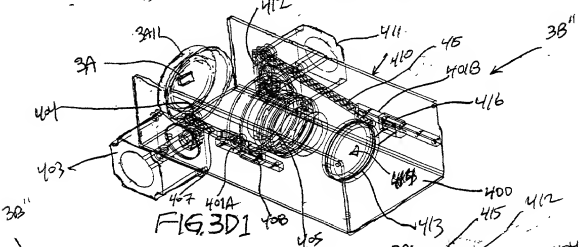

FIG 3D1

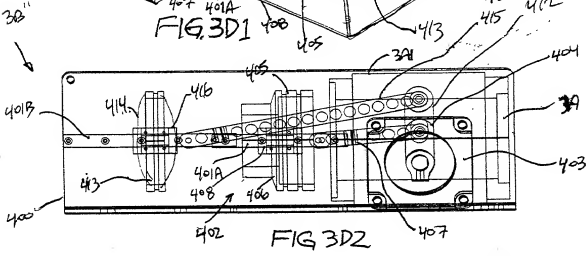

FIG 3D2

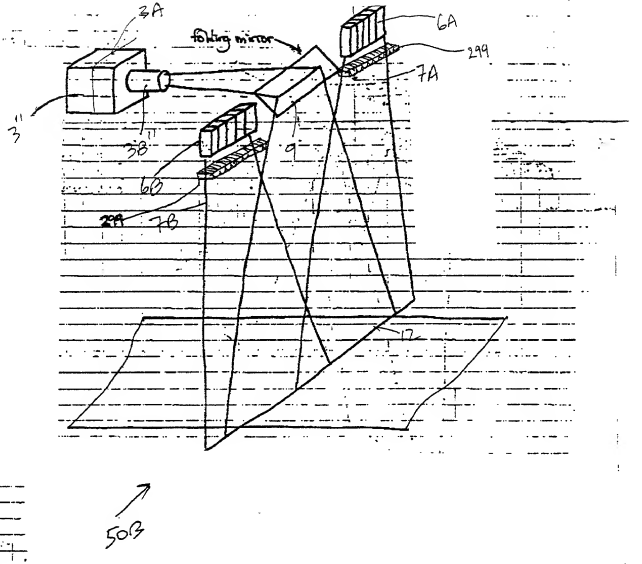

FIG 3E1

TD92TT DETE8B6D

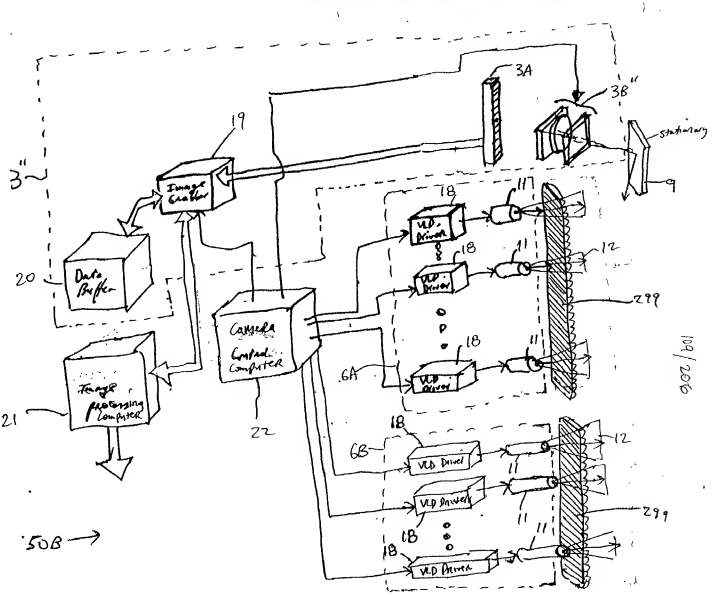

FIG. 3E2

T092TT'DETE886D

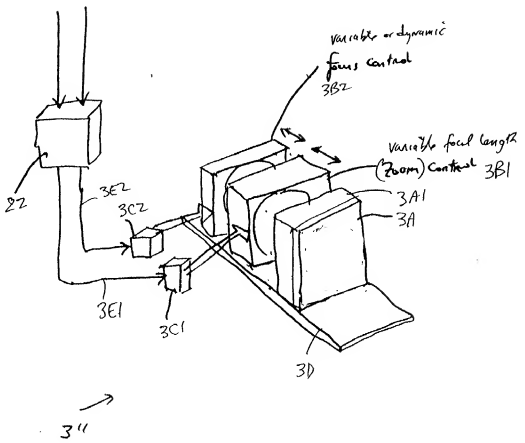

FIG. 3E3

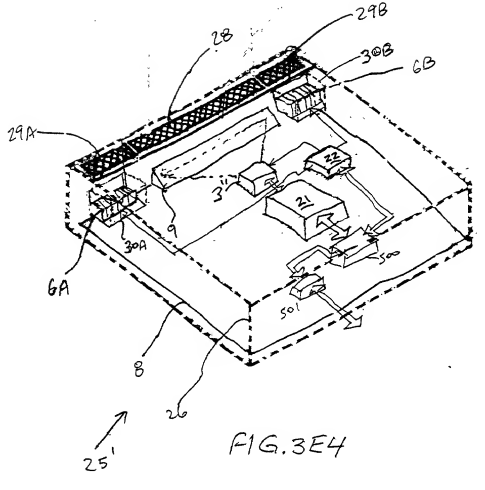

FIG. 3E4

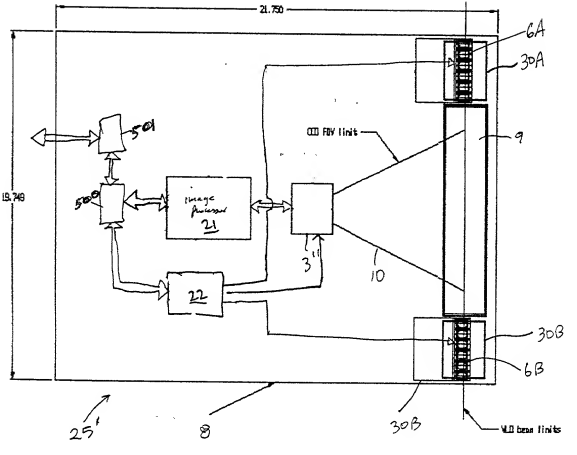
21.750
15.749
6A
30A
9
CCD FOV limits
50
50
Image Analyzer
21
22
3
10
30B
6B
25'
8
30B
WLD beam limits

FIG. 3E5

US9211077B2

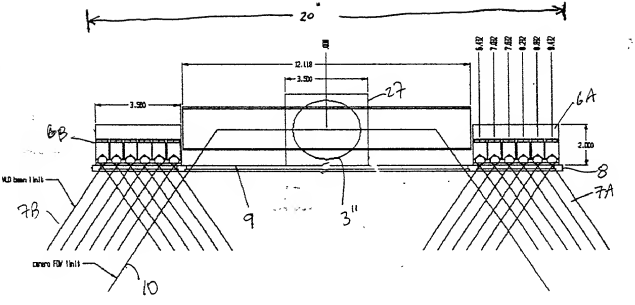

FIG. 3E6

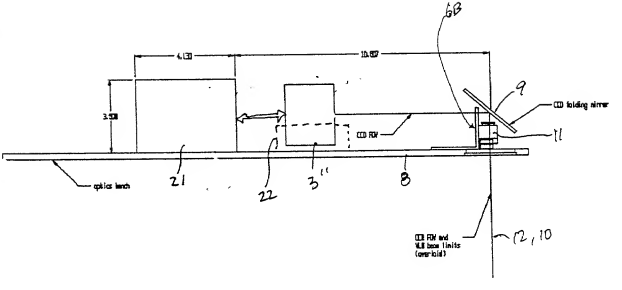
68
4.0
10.65
9
holding mirror
3.50
FOV
11
optics bench
21
22
3''
8
FOV and WLE base limits (overlaid)
12, 10

FIG. 3E7

10921.0515B8D

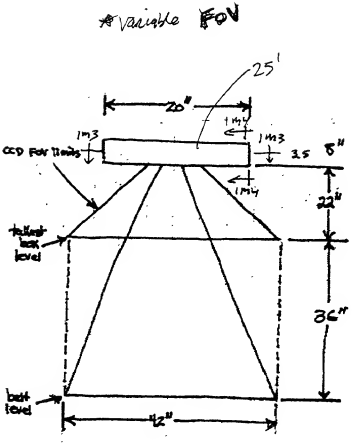

FIG. 3E8

FOIPLE-DE5850

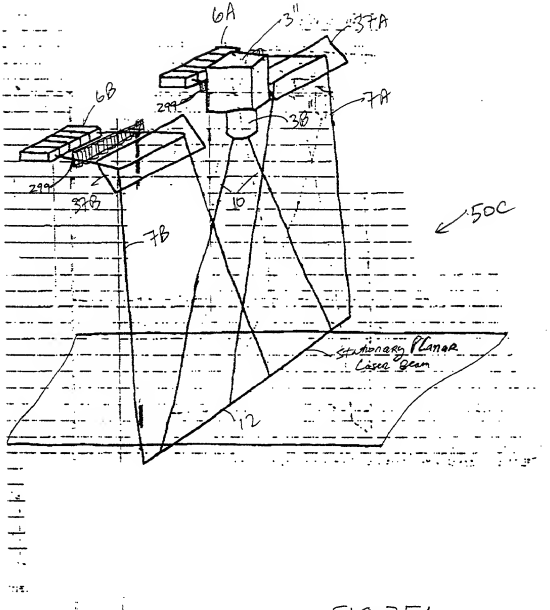

FIG. 3F1

T092TT' DETE886D

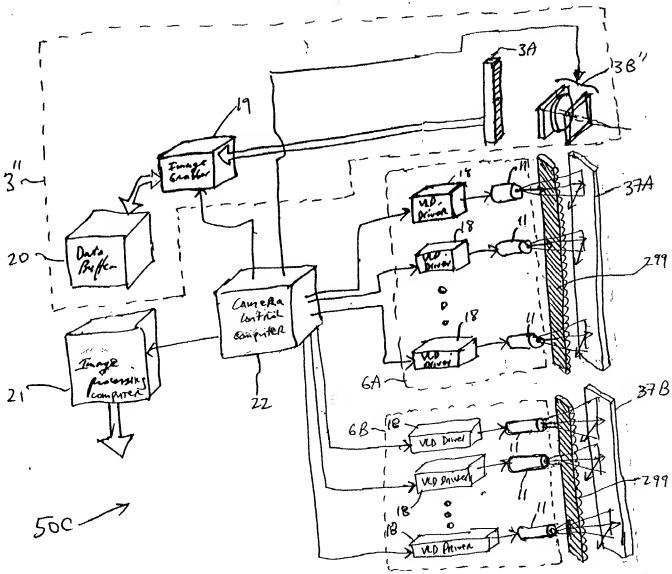

FIG. 3F2

11/2006

T092TT' 0ETE8860

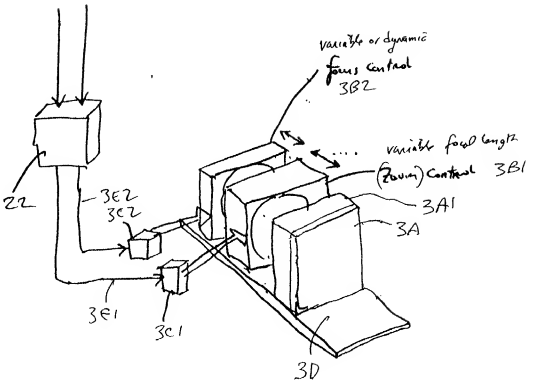

FIG. 3F3

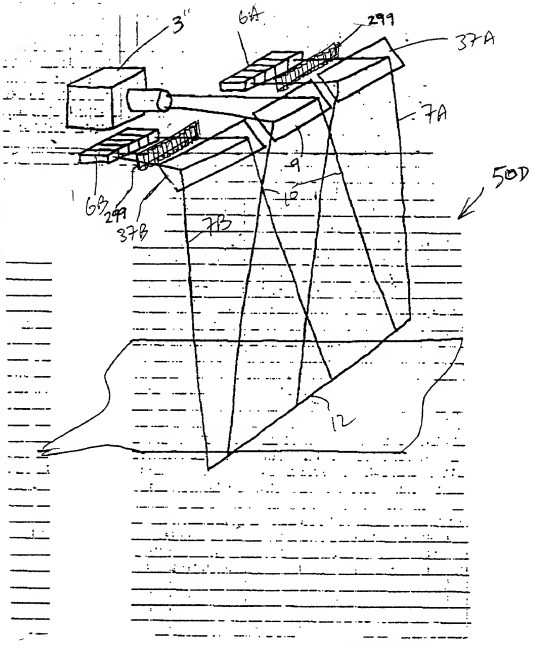

FIG. 361

09853130 '112601

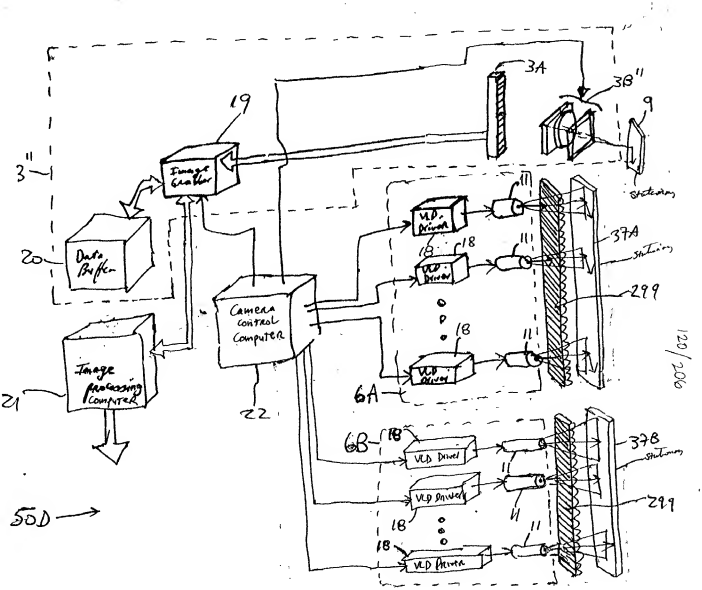

FIG. 3G2

T092TT'0ETE8B6D

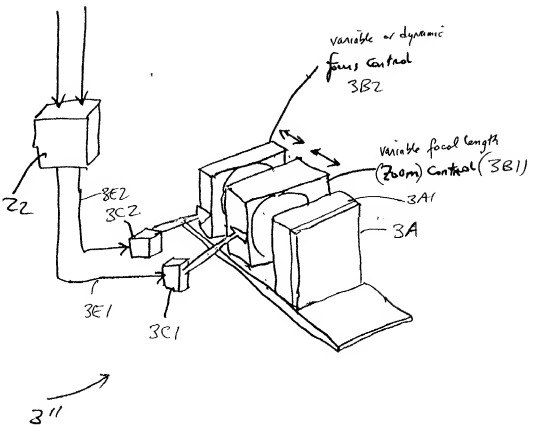

FIG. 3G3

12/1 200

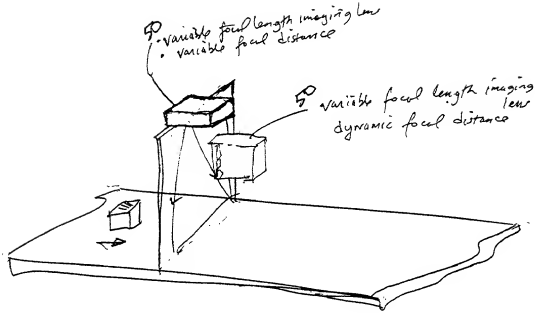
variable focal length imaging lens
• variable focal distance
variable focal length imaging lens
dynamic focal distance

FIG. 3H

T092TT'0ETE8860

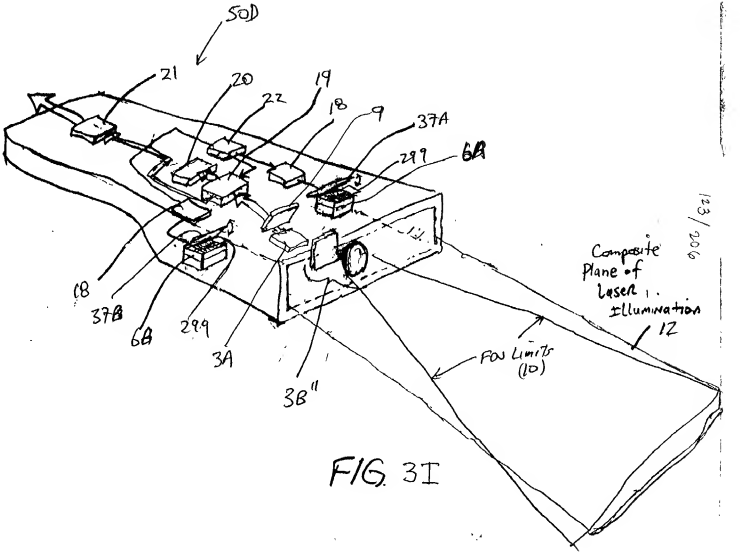

FIG. 3I

T092TT" DETE8860

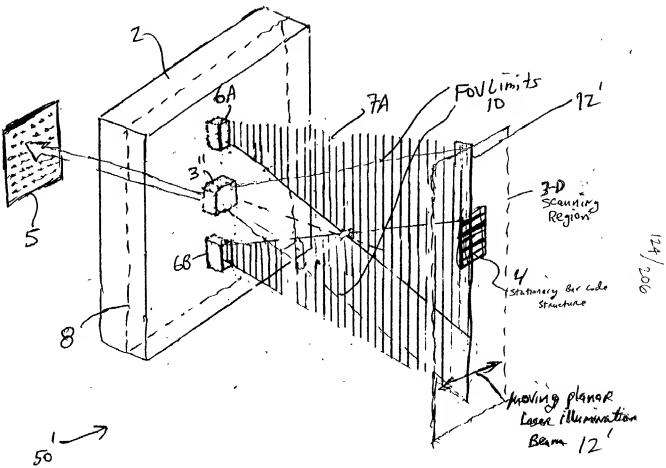

FIG. 3J1

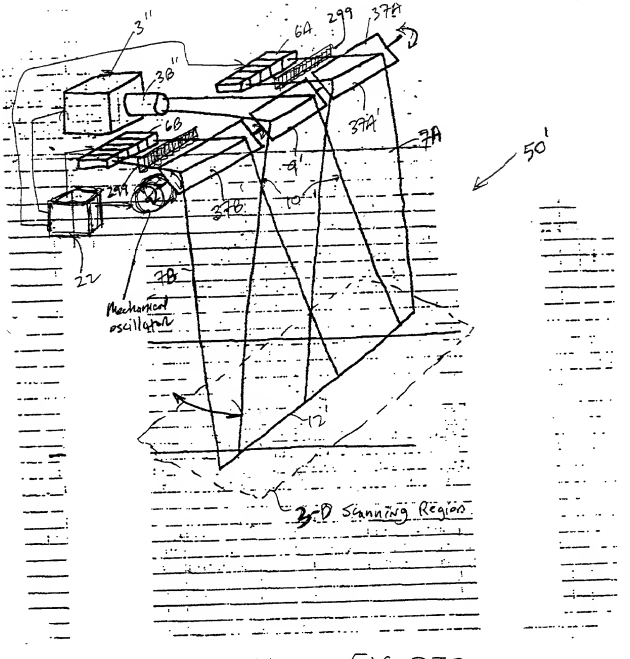
3''
38''
66
299
37A
64
37A'
7A
50'
9'
10'
37B
7B
22
Mechanical oscillator
12'
3-D Scanning Region

FIG 3J2

09883130 "112501

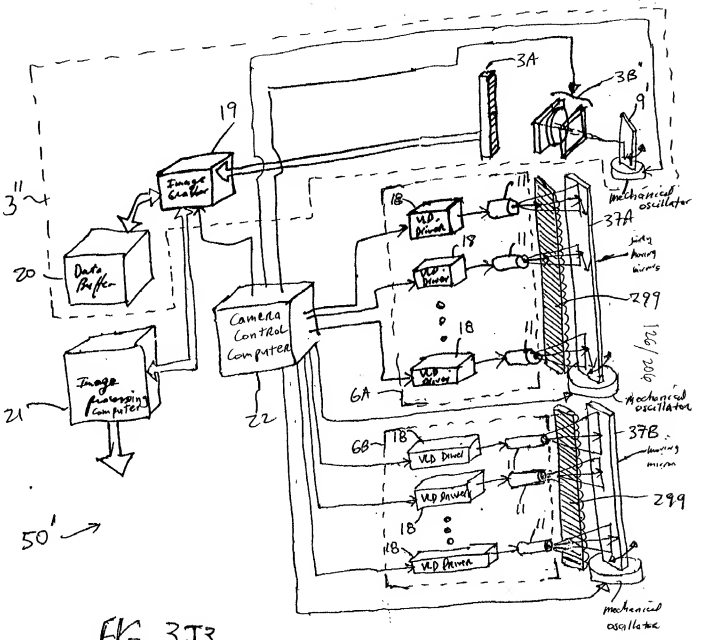

FIG. 3J3

T092TT'0ETE9860

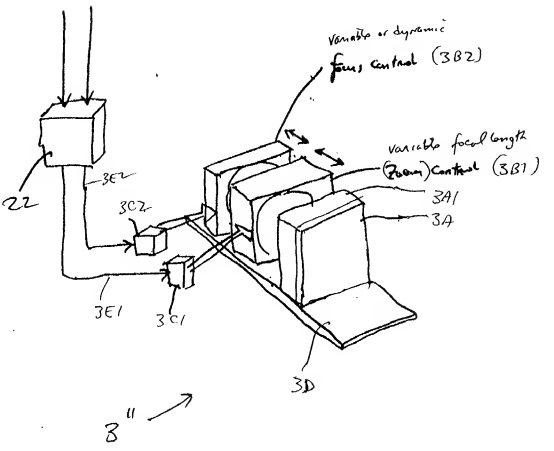

FIG. 3J4

TD92TT·DETE8860

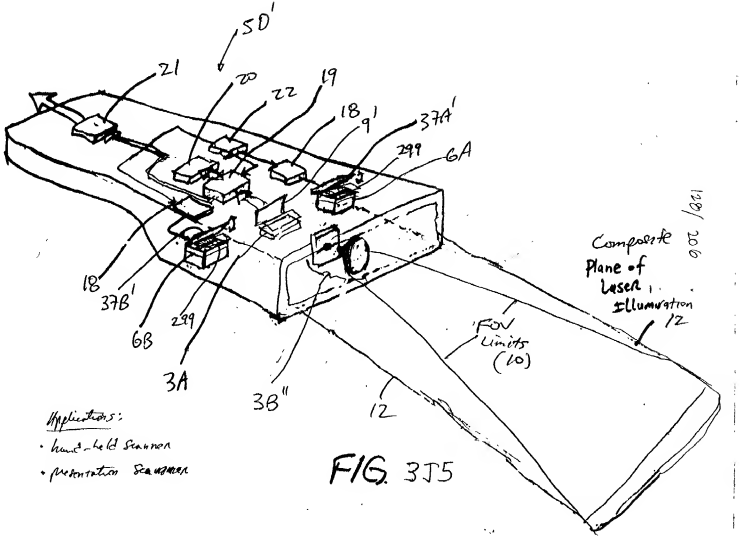

FIG. 3J5

PCT/US2015/062...

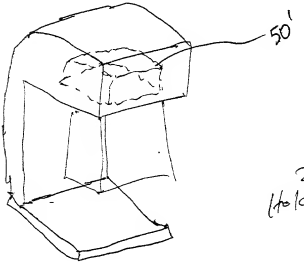

FIG. 3J6

TD92TT'0ETE8860

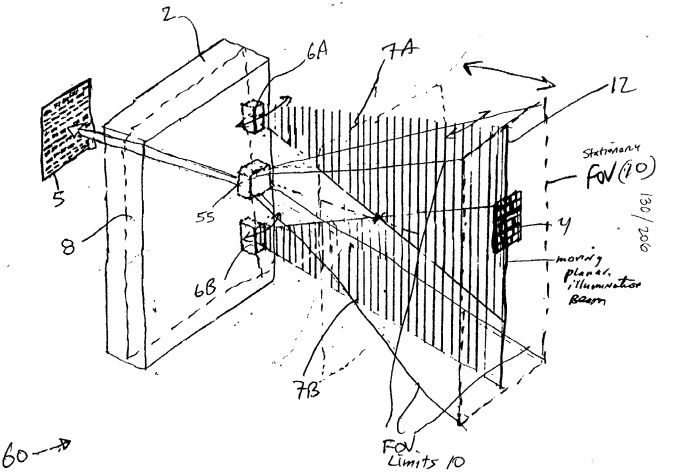

FIG 4A

PATENT DRAWING

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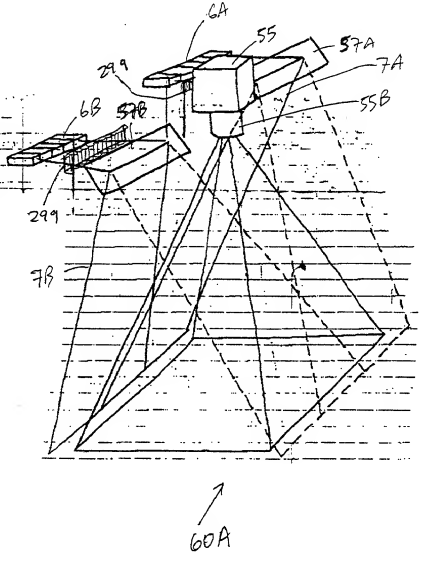
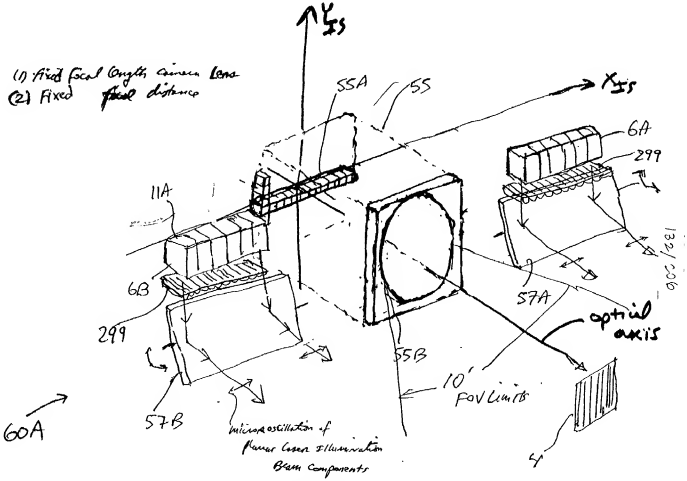


FIG. 4B1

US 2011/0298898 A1



TD92TT'0ETE8860

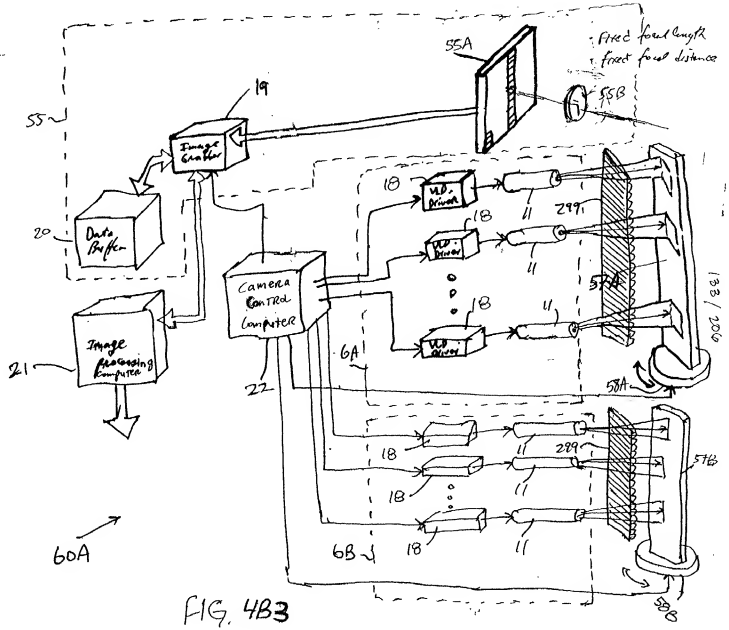


FIG. 4B3

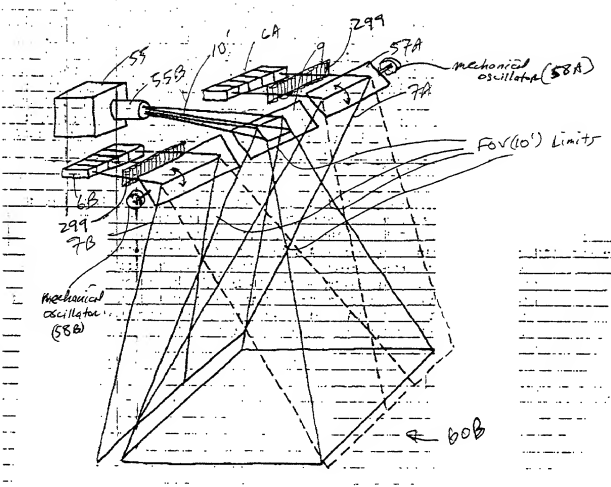

55
55B
10'
CA
9
299
57A
mechanical oscillator (58A)
7A
FOV(10') Limit
6B
299
7B
mechanical oscillator (58B)
60B

FIG. 4C-1

TD92TT'0ETE8860

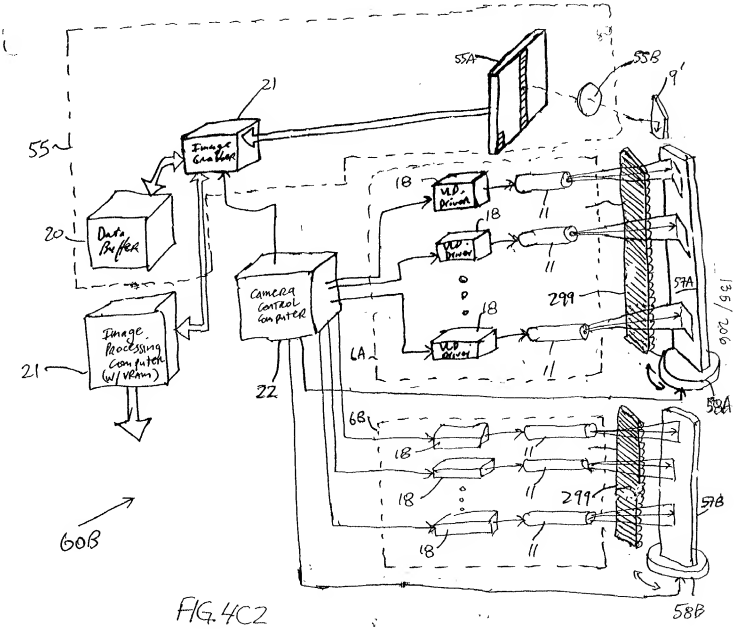


FIG. 4C2

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SUBSTITUTE SHEET (RULE 26)

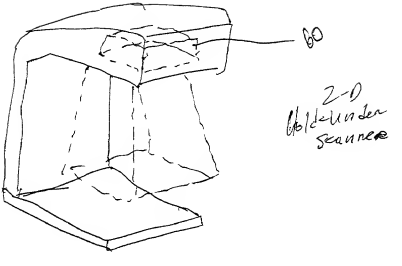

FIG. 4D

TD92TT'DCTE8860

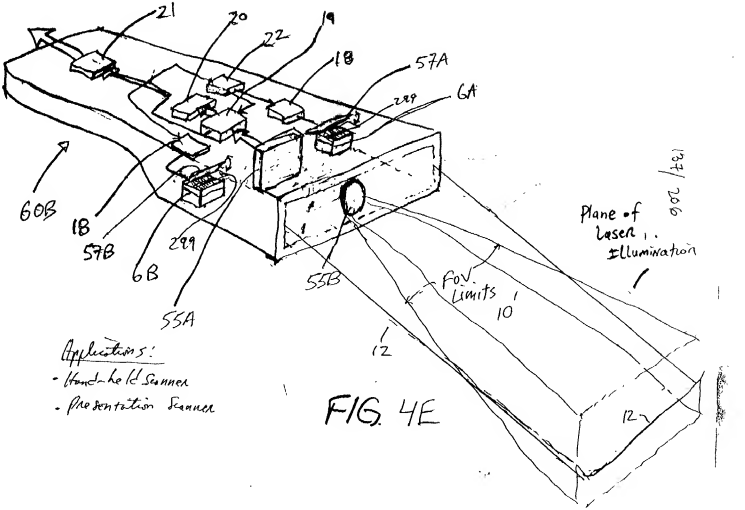

FIG. 4E

09883130 .11250L

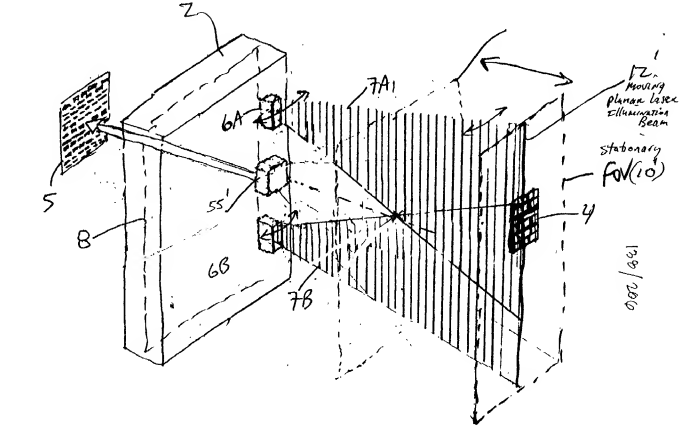

FIG 5A

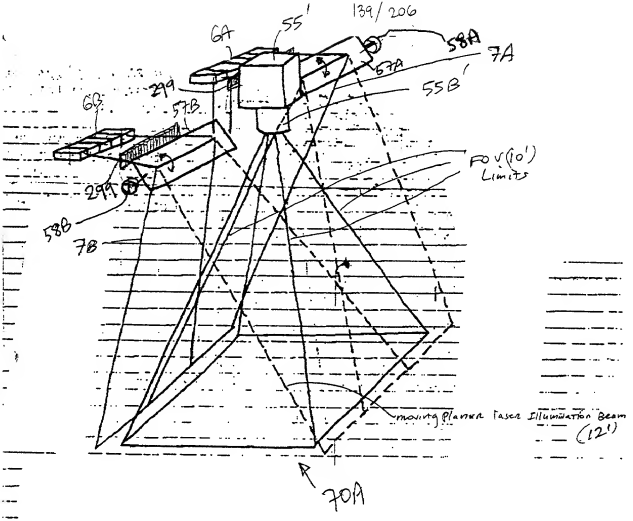
139/206
55'
6A
58A
7A
57A
55B'
299
57B
6B
FOV(10') Limits
299'
58B
7B
Moving Planar Laser Illumination Beam (12')
70A

FIG 5B1

TD92TT*DCTE8860

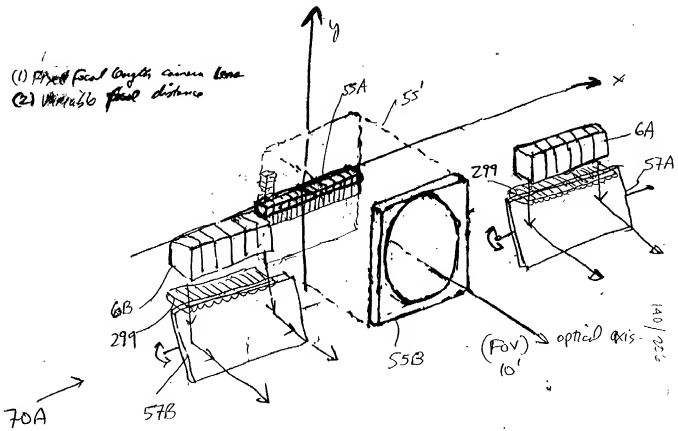

FIG. 5B2

TD92TT'0ETE8060

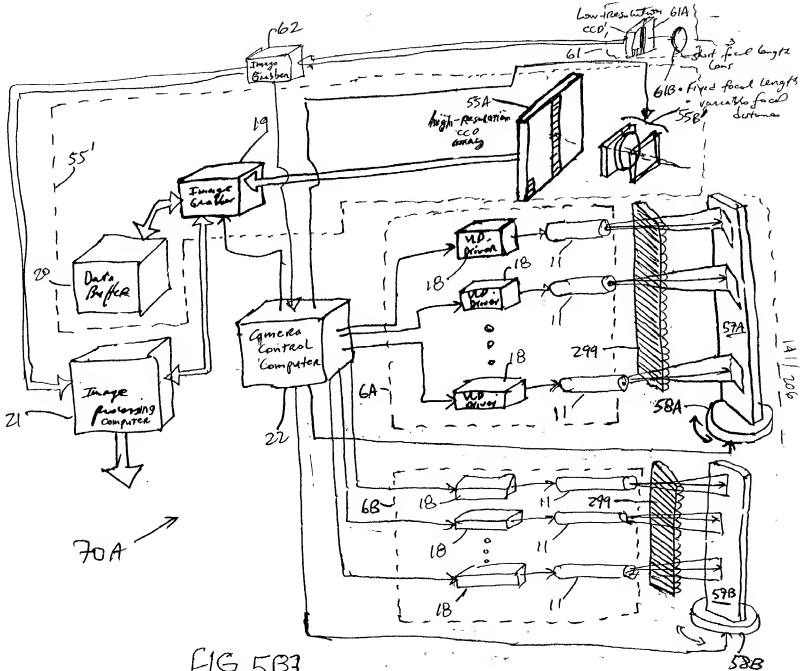

FIG. 5B3

TD92TT' DETE9860

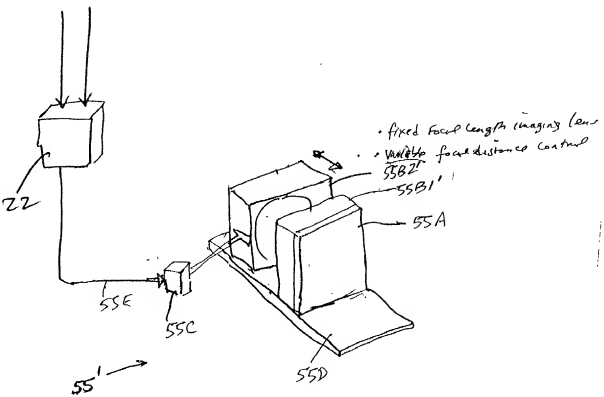

FIG. 5B4

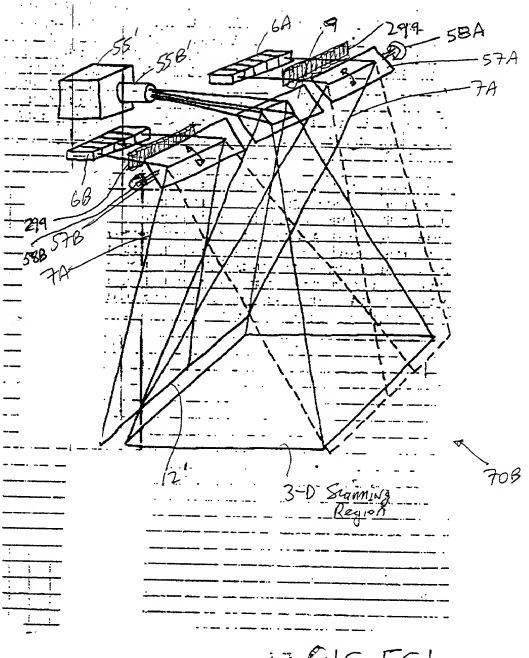
55
55'
6A
9
299
58A
57A
7A
6B
299
57B
58B
7A
12'
3-D Scanning Region
70B

FIG. 5C1

TD92TT'0ETE886D

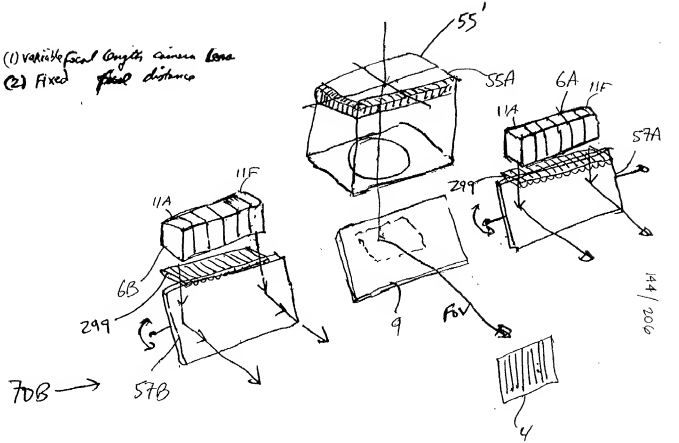

FIG. 5C

T092TT'DETE8860

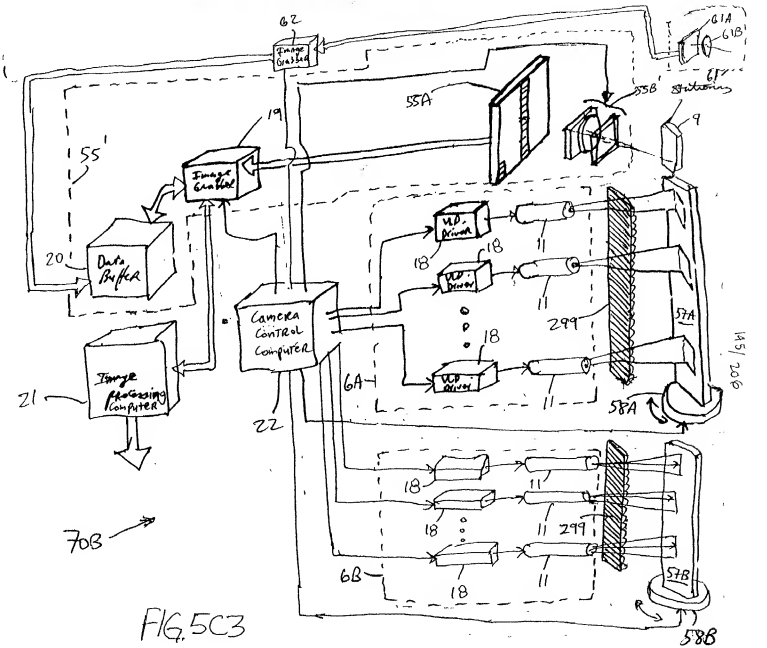

FIG. 5C3

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TO92TT'DETE8B6D

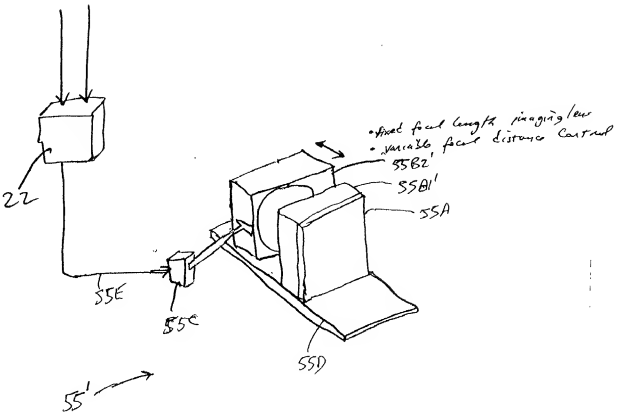

FIG. 5C4

Replacement Sheet

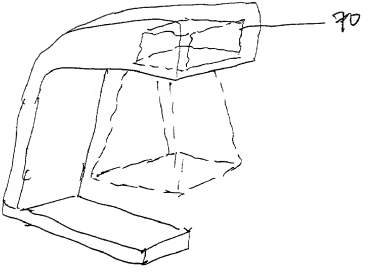

FIG. 5D

T092TT"DETE8860

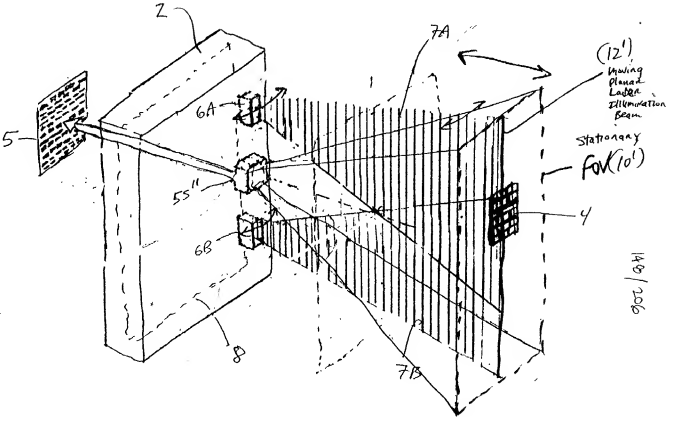

FIG. 6A

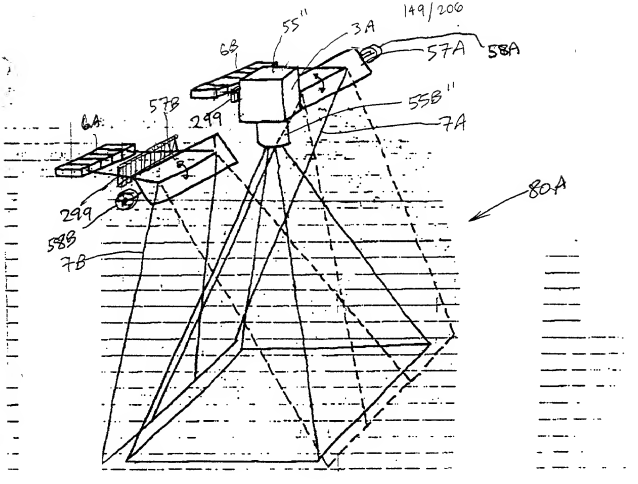

FIG. 6B1

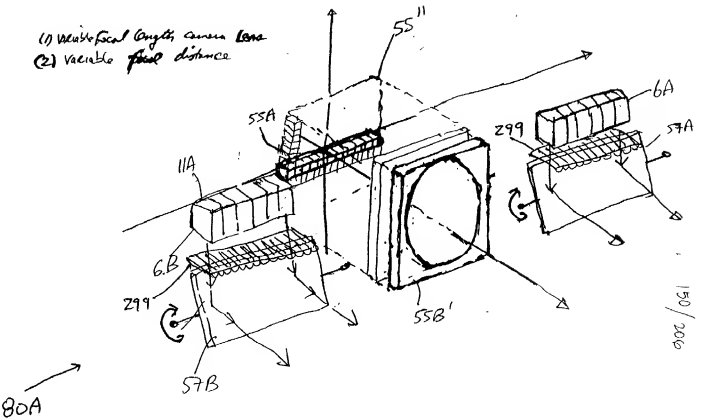
(1) Variable focal length camera lens
(2) Variable focal distance
55''
55A
11A
6A
6B
Z99
Z99
57A
55B'
57B
80A
150/206

FIG. 6B2

TD92TT*0ET88860

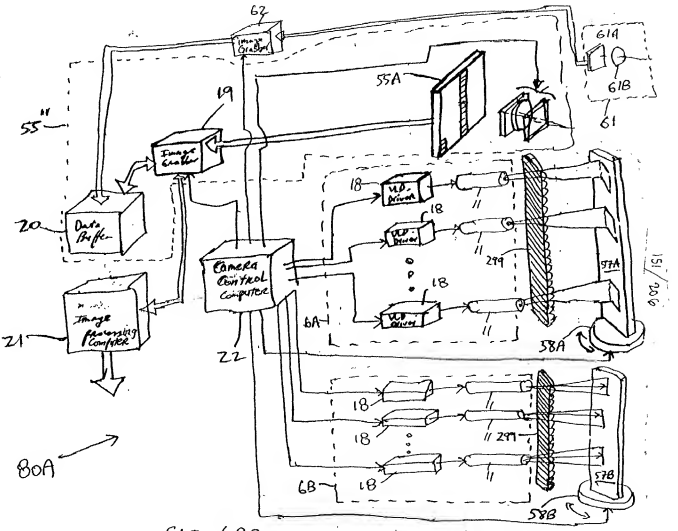

FIG. 6B3

09893130.112601

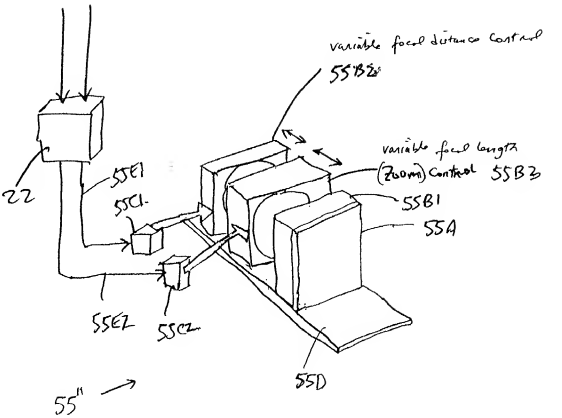

FIG. 6B4

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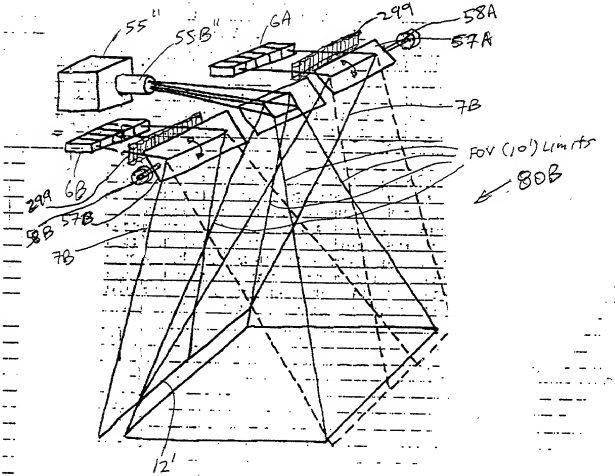

FIG. 6C1

TD92TT'OETE8860

(1) Variable focal length camera lens
(2) Variable focal distance

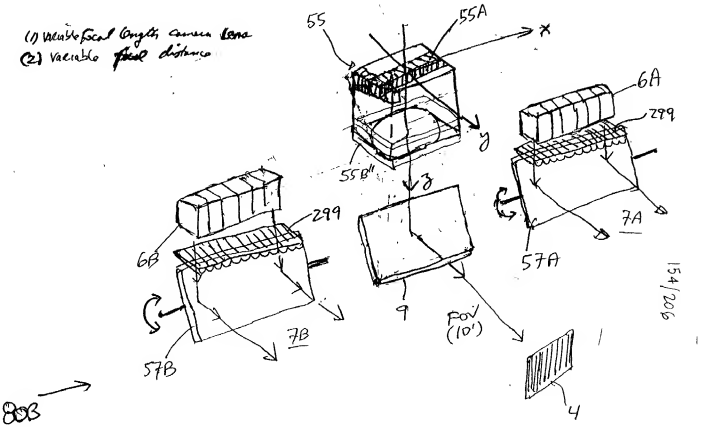

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FIG. 6C2

TD92TT' 0ETE886D

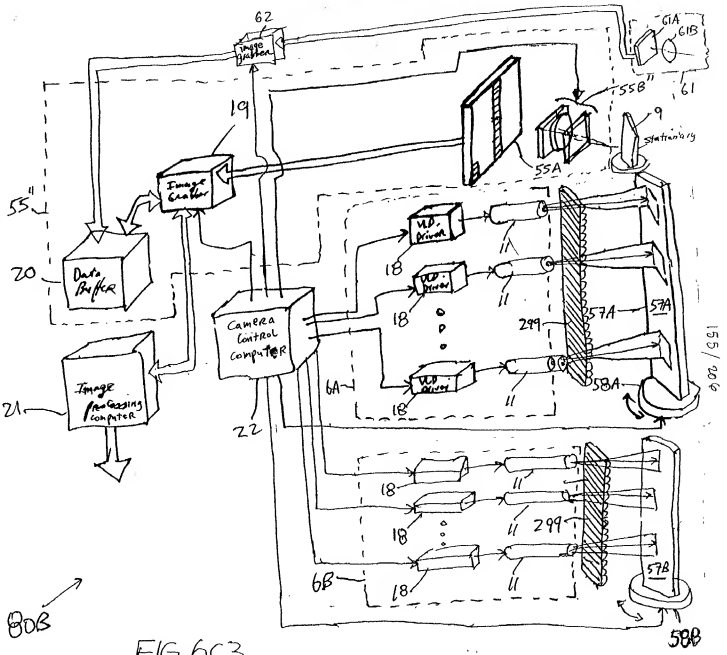

FIG. 6C3

D9883130.11250L1

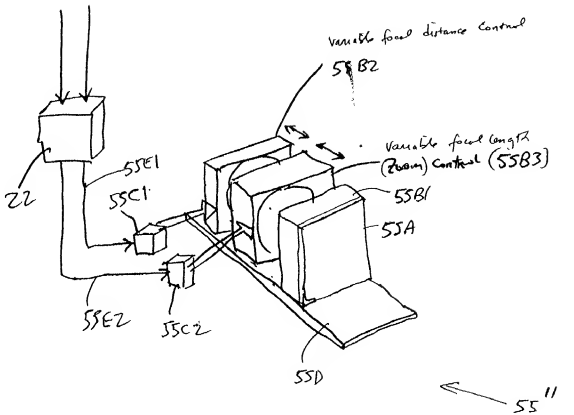

FIG. 8C4

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SUBSTITUTE SHEET (RULE 26)

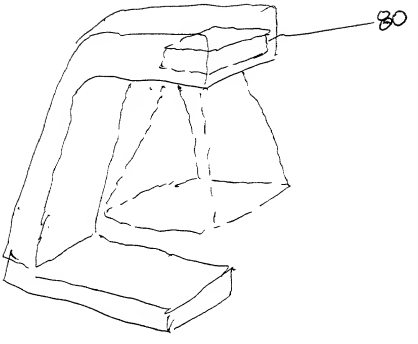


FIG. 6C5

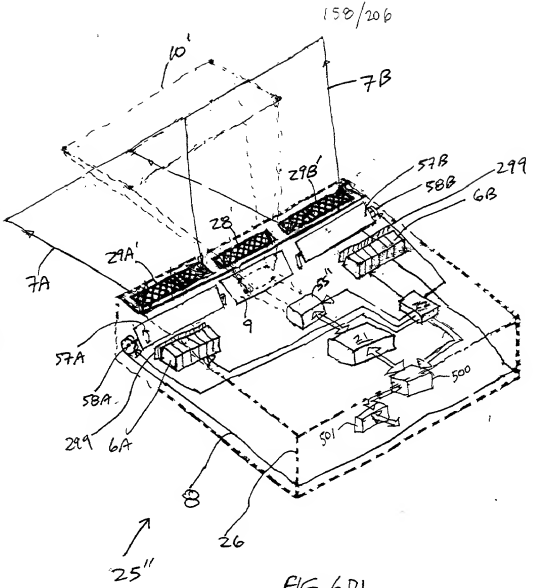


FIG. 6D1

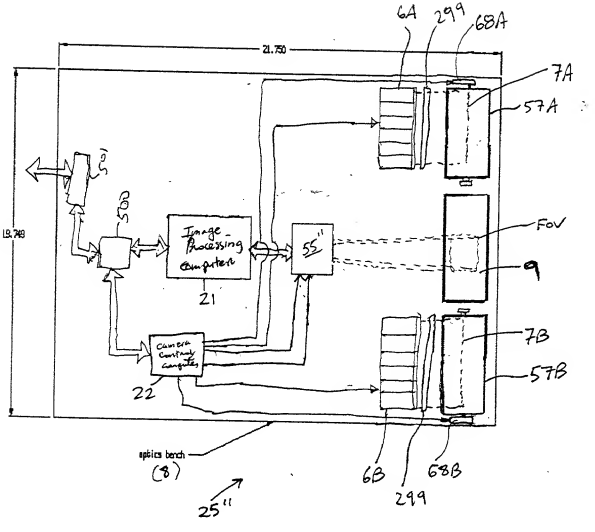

6A
299
68A
7A
57A
21.750
15.748
5
8
Image-Processing Computer
55"
21
FoV
9
Camera Control Computer
22
7B
57B
optics bench
(8)
25"
6B
299
68B

FIG. 6D2

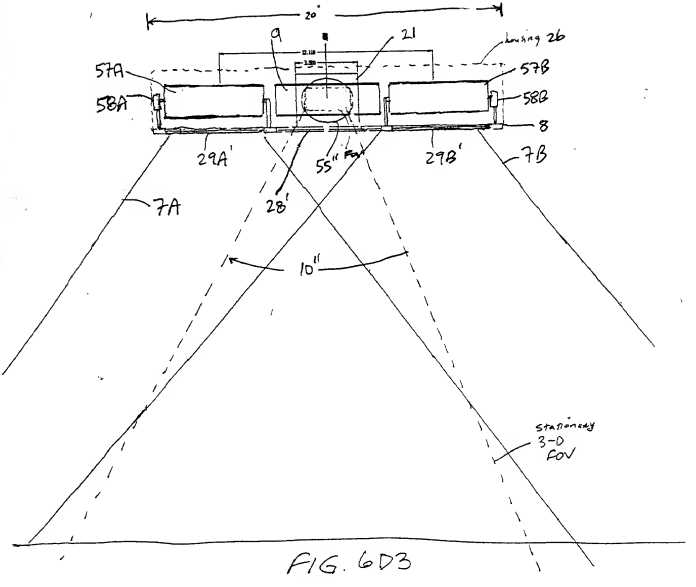

20"
9
21
housing 26
57A
57B
58A
58B
8
29A'
55" FOV
29B'
7B
7A
28'
10"
stationary
3-D
FOV

FIG. 6D3

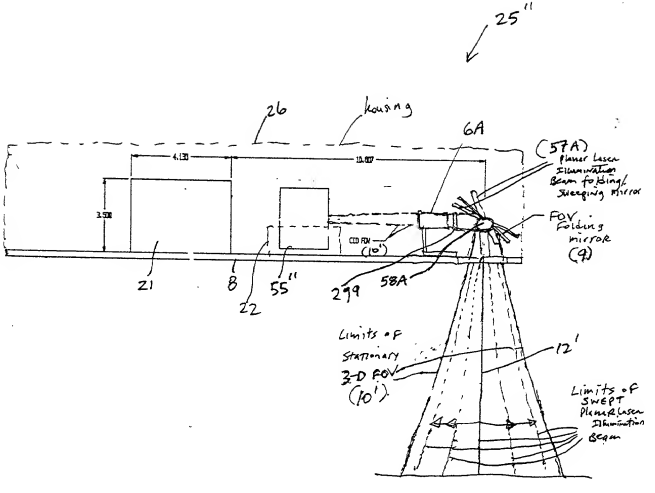

25''
housing
26
6A
(57A)
Planar Laser Illumination Beam folding/ steering mirror
FOV Folding mirror (9)
4.13
13.97
3.50
CCD FOV (10')
21
8
22
55''
279
58A
Limits of Stationary 3-D FOV (10')
12'
Limits of SWEPT Planar Laser Illumination Beam

FIG. 6D4

WO 2011/005238 PCT/US2009/049863

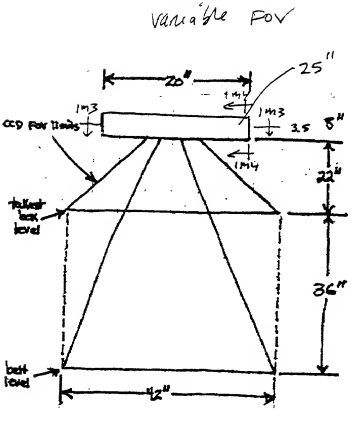


FIG. 6D5

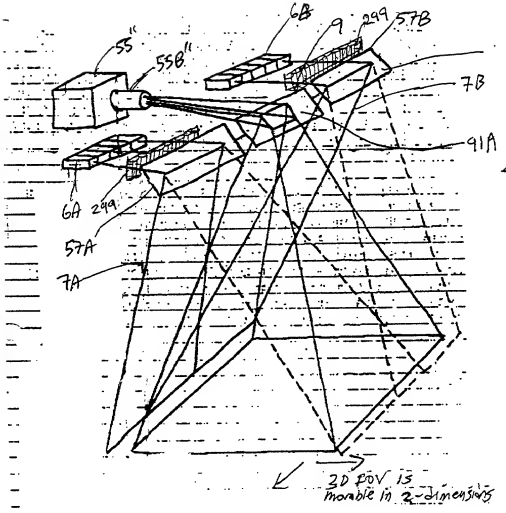

6B
9
299
57B
55"
55B"
7B
91A
90
6A
299
57A
7A
3D POV is
movable in 2 dimensions

FIG 6E1

T092TT'0CTE886D

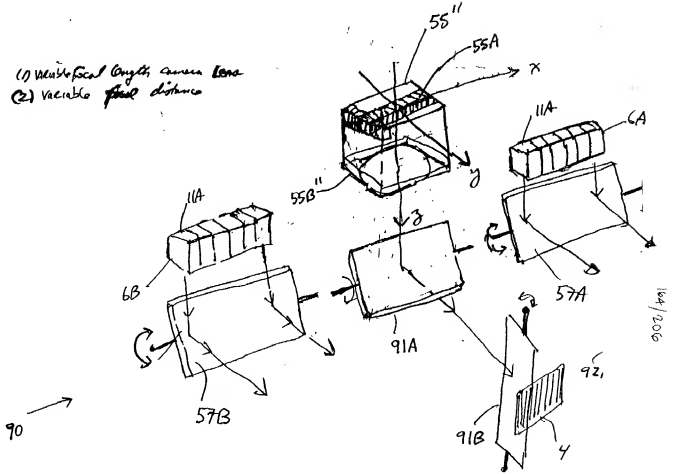


FIG. 6E2

09883130 .112601

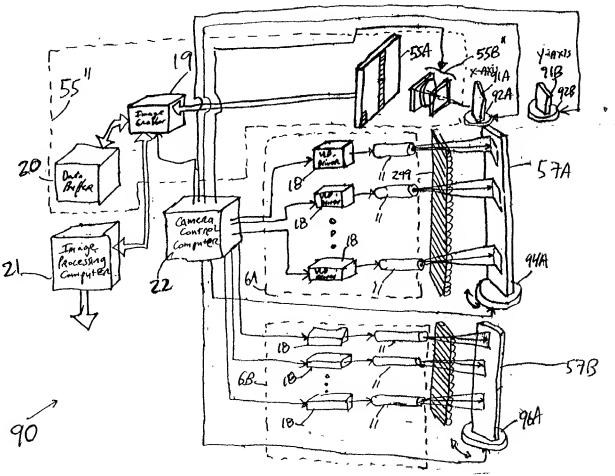


FIG. 6E3

160/200

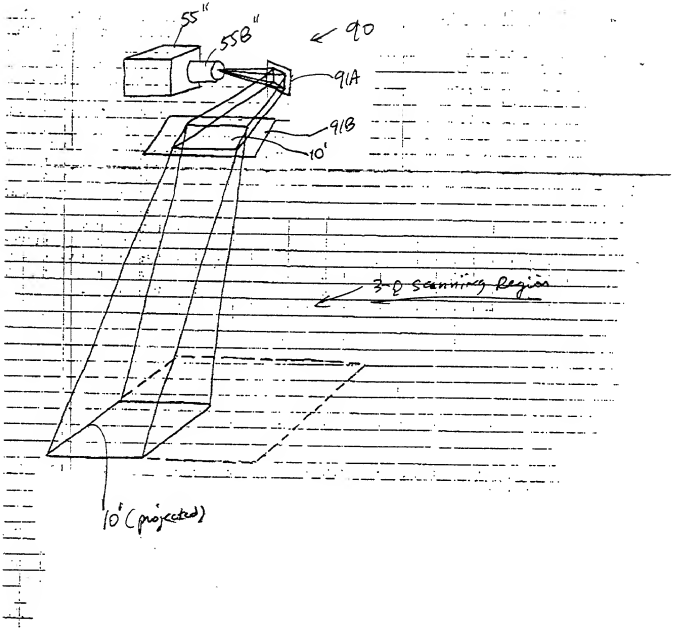


FIG. 6E4

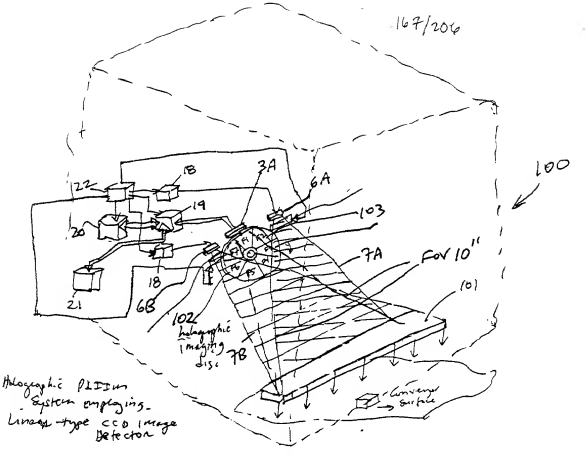

100
3A
6A
103
7A
FoV 10''
101
18
19
20
22
21
6B
102
Holographic imaging dis. 7B
Holographic PLIIM System employing Linear-type CCD Image Detector
Conveyor surface

FIG. 7A

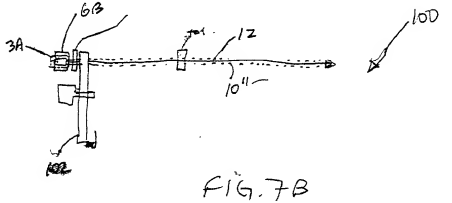

6B
3A
12
100
10''
102

FIG. 7B

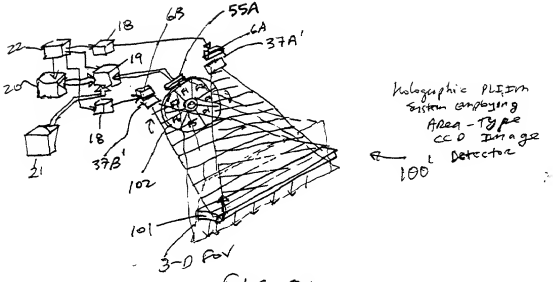

22
18
6B
55A
CA
37A'
19
20
18
37B'
21
102
101
3-D FoV
Holographic PLIIM Station employing Area-Type CCD Imager
100'
Detector

FIG. 8A

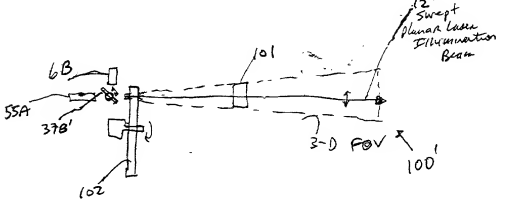

12'
Swept Planar Laser Illumination Beam
101
6B
55A
37B'
3-D FoV
100'
102

FIG. 8B

09823730 "112501

1-D CCD SCANNER EMBODIMENT

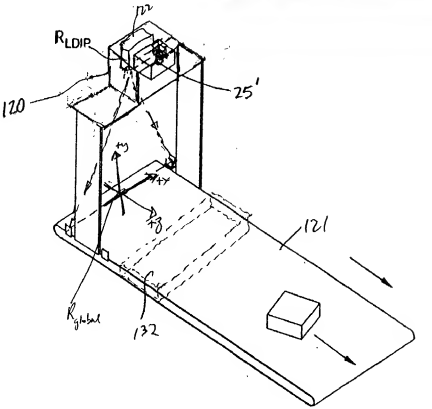


FIG. 9

TD92TT' DETE8860

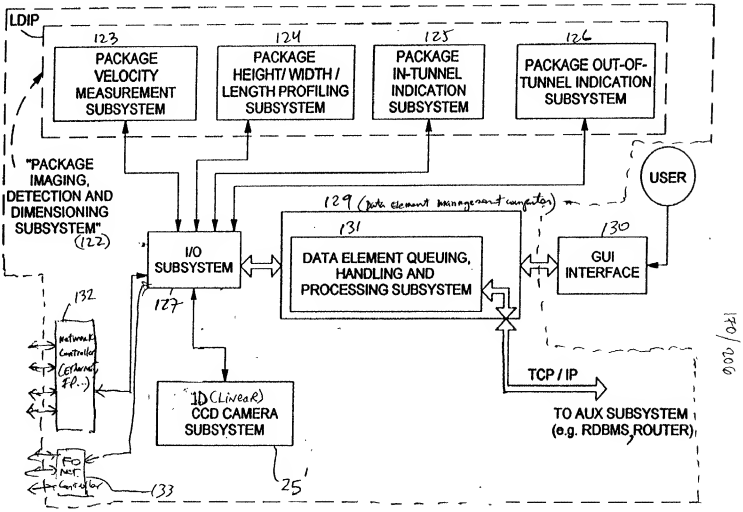


FIG. 10

US 2009/0134221 A1

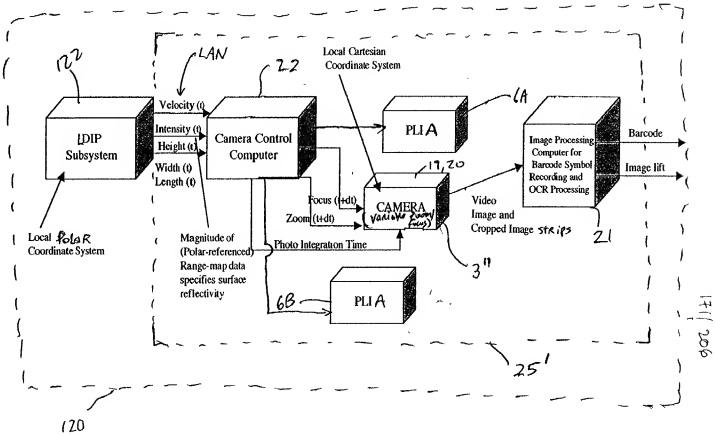


FIG. 11

PATENT-US-030850

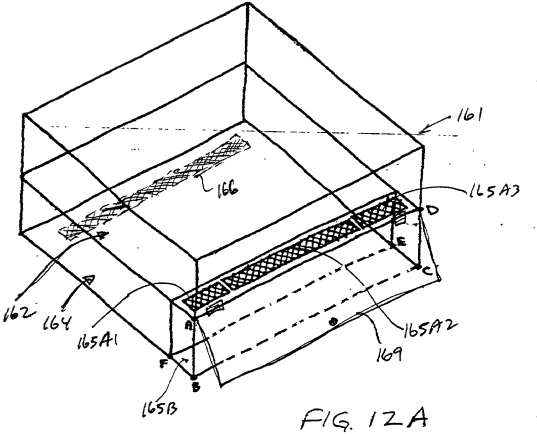


FIG. 12A

T092TT'DETE8860

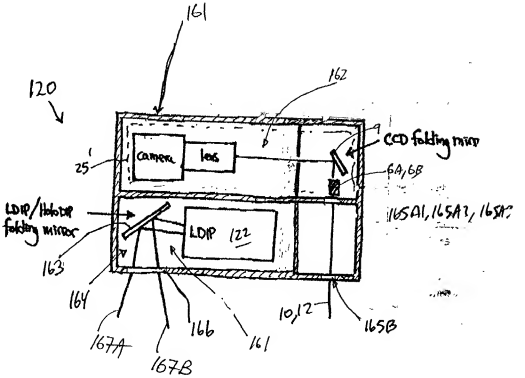


FIG. 12B

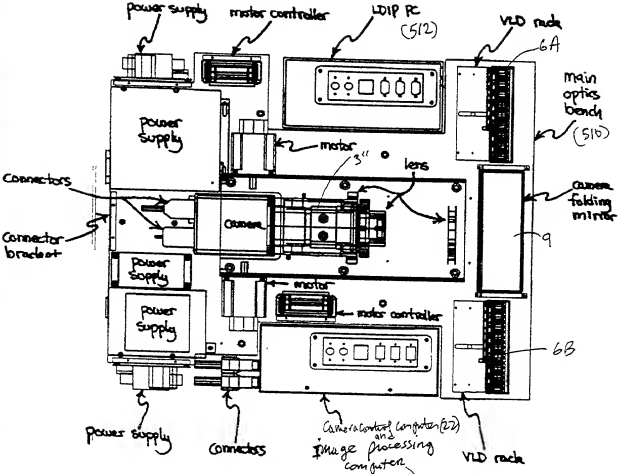

power supply
motor controller
LDIP PC (512)
VLD rack
6A
main optics bench (510)
power supply
motor
3"
lens
camera folding mirror
connectors
camera
connector bracket
9
power supply
motor
power supply
motor controller
6B
power supply
connectors
camera control computer (22) and image processing computer (21)
VLD rack

FIG. 12C

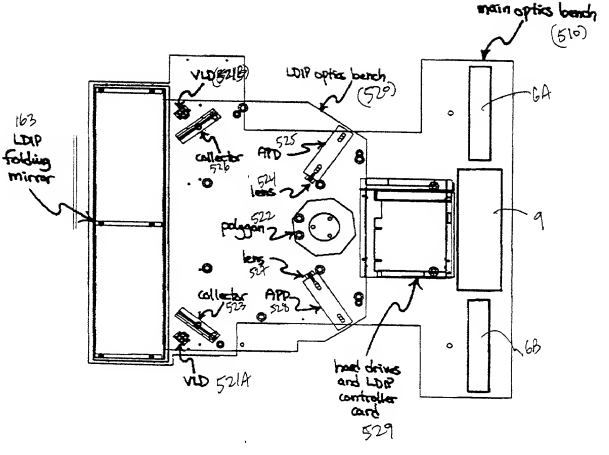
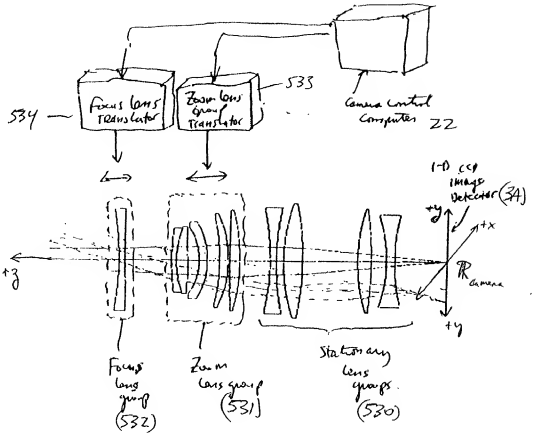

main optics bench
(510)
VLD (521B)
LDIP optics bench
(529)
6A
163
LDIP
folding
mirror
collector
526
APD
525
lens
524
polygon
522
9
lens
527
collector
523
APD
528
6B
VLD 521A
head drives
and LDIP
controller
card
529

FIG. 12D

T092TT'DETE8860



(-main optics)
(Lens groups)

FIG. 12E

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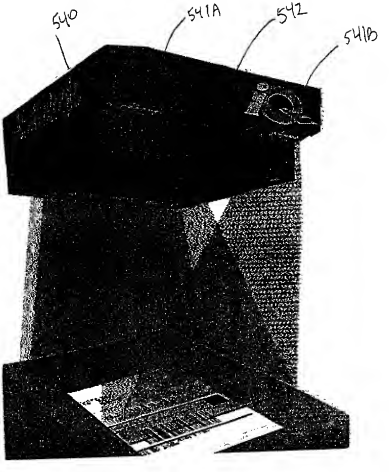


FIG. 13A

EXHIBIT 1033 PAGE 197

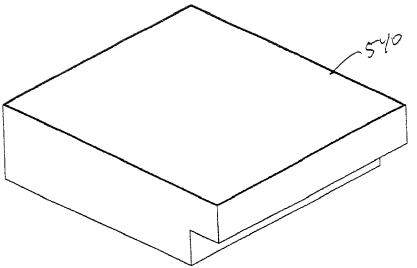


FIG. 13B

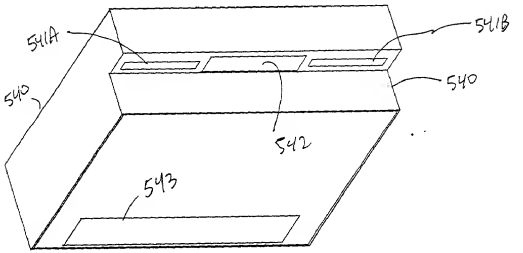


FIG. 13C

PLLIM-BASED PACKAGE IDENTIFICATION AND DIMENSIONING (PID) SYSTEM

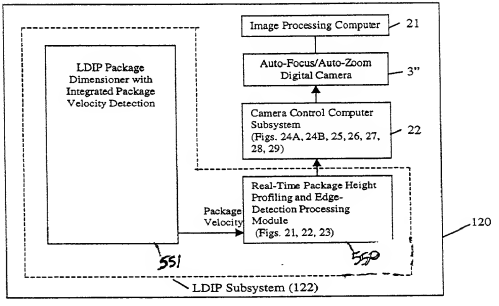


FIG. 14

LDIP REAL-TIME PACKAGE HEIGHT PROFILE AND EDGE DETECTION METHOD

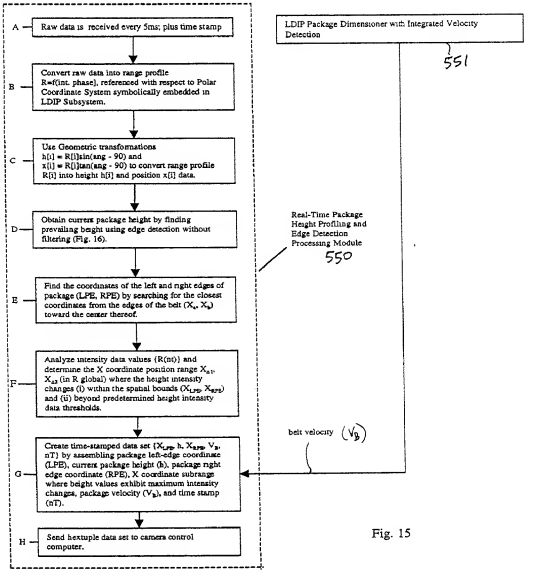
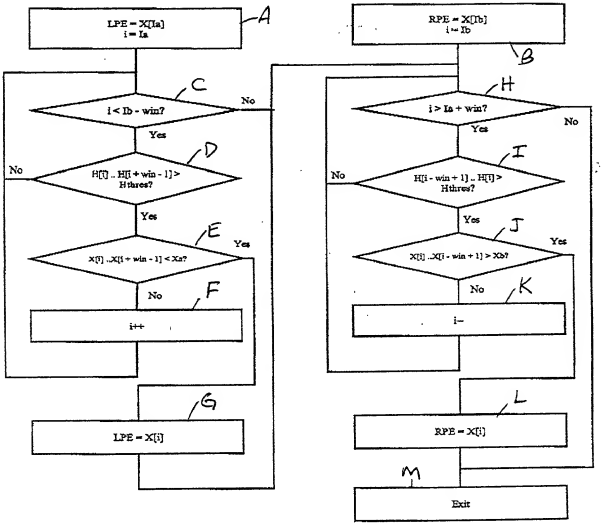


Fig. 15

LDIP Real Time Package Edge Detection



Xa = location of belt left edge; Xb = location of belt right edge
Ia = belt edge edge pixel; Ib = belt right edge pixel
LPE = Left package edge; RPE = Right package edge
H[] = Pixel height array; X[] = Pixel location array
win = package detection window

FIG. 16

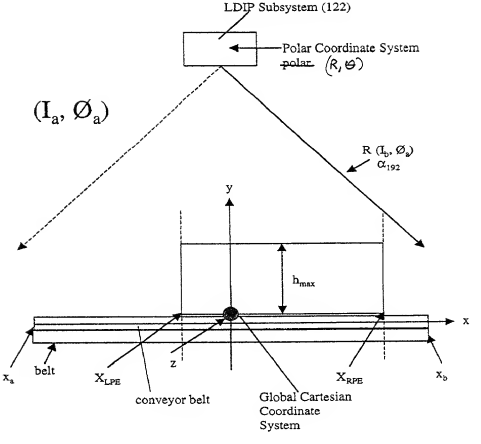

LDIP Subsystem (122)
Polar Coordinate System
polar (R, Θ)
(I_a, Ø_a)
R (I_b, Ø_b)
α_192
y
h_max
x
z
x_a
belt
X_LPE
conveyor belt
X_RPE
x_b
Global Cartesian Coordinate System

Fig. 17

INFORMATION MEASURED AT SCAN ANGLES BEFORE COORDINATE TRANSFORMS

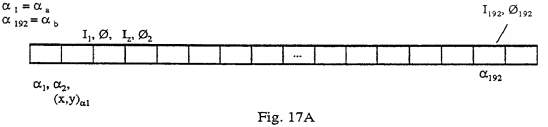


Fig. 17A

RANGE AND POLAR ANGLE MEASURES TAKEN AT SCAN ANGLE α BEFORE COORDINATE TRANSFORMS

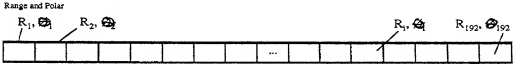


Fig. 17B

MEASURED PACKAGE HEIGHT AND POSITION VALUES AFTER COORDINATE TRANSFORMS

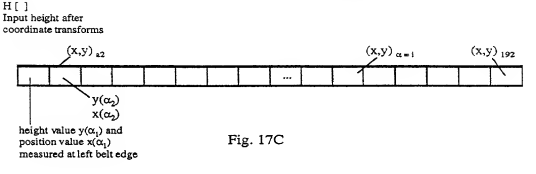


Fig. 17C

CAMERA CONTROL PROCESS CARRIED OUT WITHIN THE CAMERA CONTROL SUBSYSTEM OF EACH OBJECT ATTRIBUTE ACQUISITION AND ANALYSIS SYSTEM

560

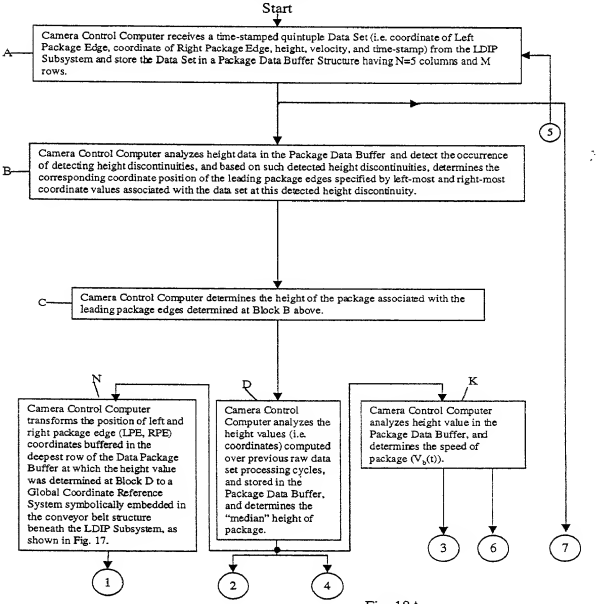


Fig. 18A

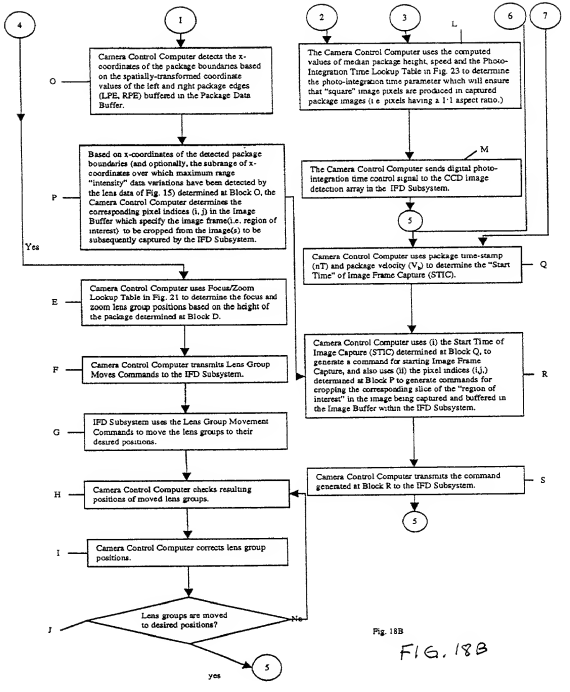


Fig. 18B

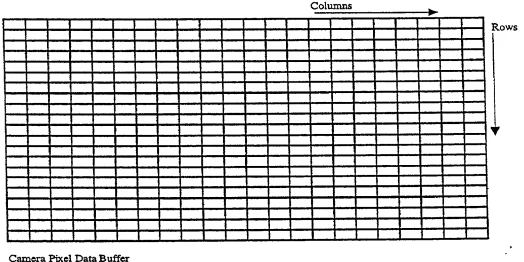
FIG. 18B

x coordinate subrange where maximum range "intensity" variations have been detected

Left Package Edge (LDE)	Package Height (h)	Right Package Edge (RPE)	Package Velocity	Time-stamp (nT)	
					Row 1
					Row 2
					Row 3
					Row 4
					Row 5
					Row M

Package Data Buffer (FIFO)

Fig. 19



Camera Pixel Data Buffer
pixel indices (i,j)

Fig. 20

T092TT"DETE8860

Zoom and Focus Lens Group position
Look-up TABLE

Distance from Camera H (mm)	Zoom group distance (mm) Y (Zoom)	Focus group distance (mm) Y (Focus)
1000	21.57489228	2.47E-05
1100	19.38089696	10.99009783
1200	17.10673434	20.65783177
1300	14.77137314	29.10917002
1400	12.39153565	36.47312595
1500	9.979114358	42.87845436
1600	7.540639114	48.44003358
1700	5.078794775	53.25495831
1800	2.595989366	57.40834303
1900	0.099972739	60.98883616

(use interpolation techniques for working distances between listed points in table)

FIG. 21

T092TT'0CT68860

* note: the focal distance & zoom (eff. focal length) of camera lens are coupled (interdependent) in this commercial embodiment. Camera has a
* fixed aperture F56

Focus and Zoom **lens movement vs. working distances**

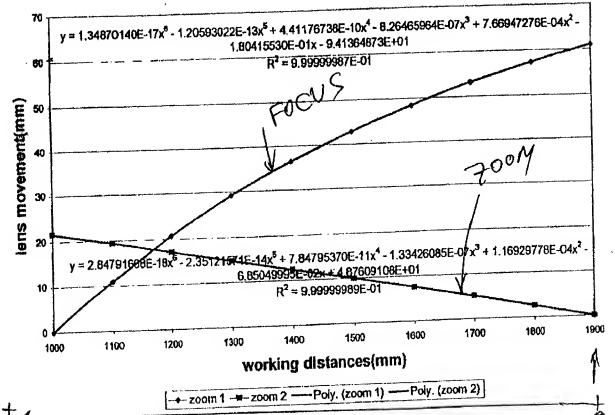


FIG 22

T092TT'0ETE8860

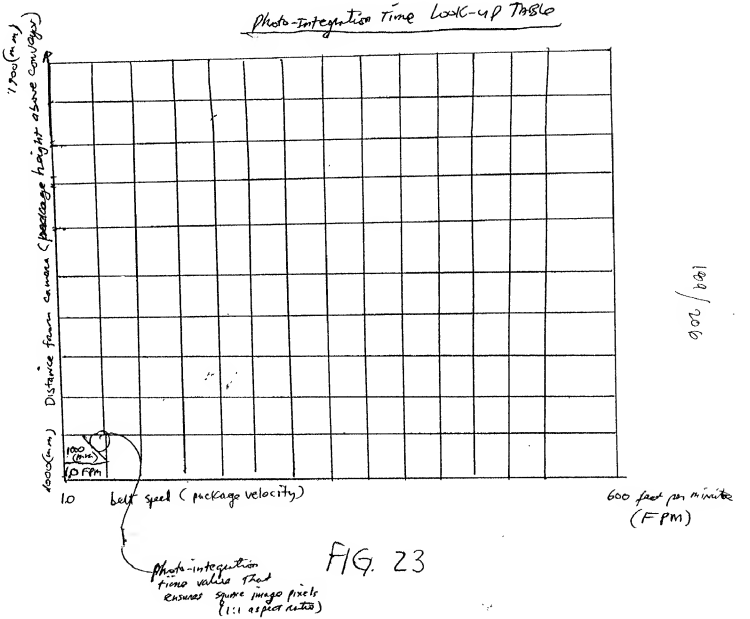


FIG. 23

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T092TT' DETE8860

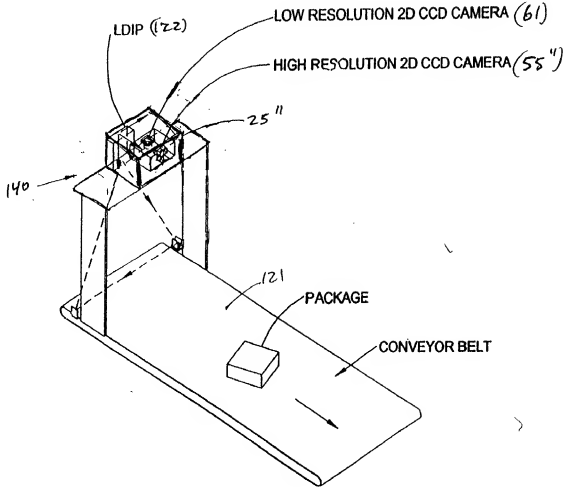

FIG 24

D09821130 .11260I

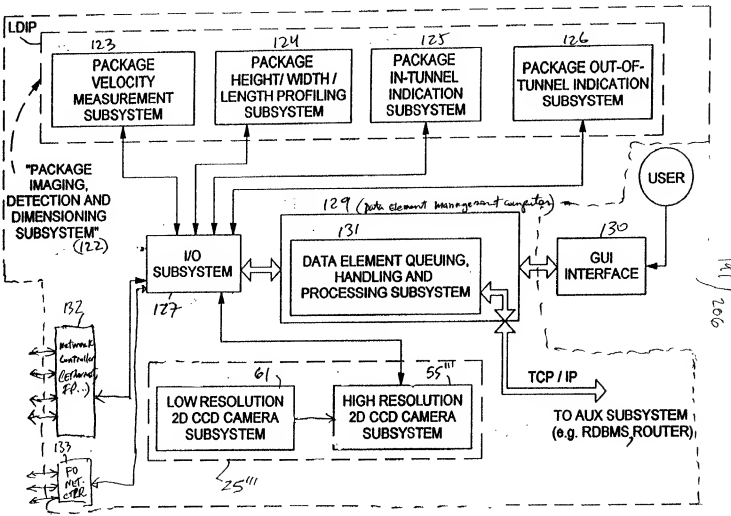

FIG. 25

T092TT' QETE8860

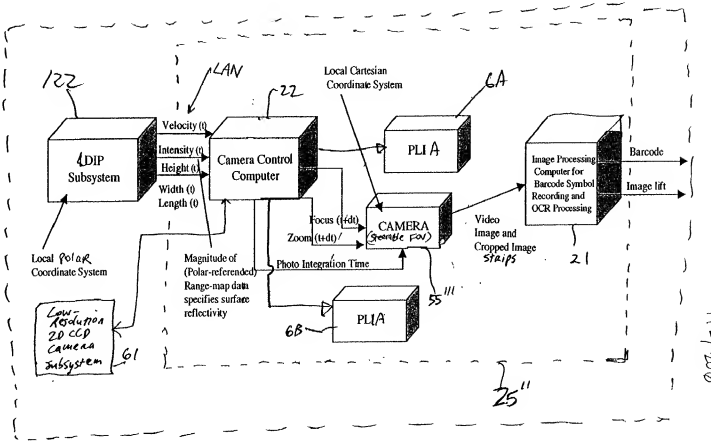

FIG. 26

140

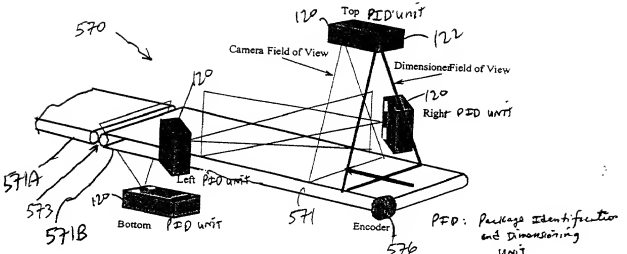
570
120
Top PID unit
122
Camera Field of View
Dimensioner Field of View
120
Right PID unit
571A
Left PID unit
573
120
571B
Bottom PID unit
571
Encoder
576
PID: Package Identification and Dimensioning unit

FIG 27

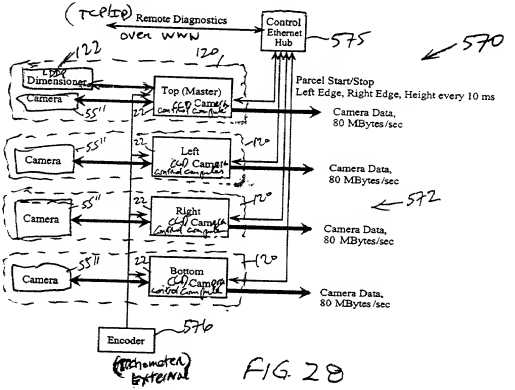
(TCP/IP)
Remote Diagnostics over WWW
Control Ethernet Hub
575
570
122
120
Laser Dimensioner
Camera
Top (Master) PID Camera Control Computer
55"
22
Parcel Start/Stop
Left Edge, Right Edge, Height every 10 ms
Camera Data, 80 MBytes/sec
Left PID Camera Control Computer
Right PID Camera Control Computer
572
Bottom PID Camera Control Computer
Encoder
576
(Tachometer External)

FIG 28

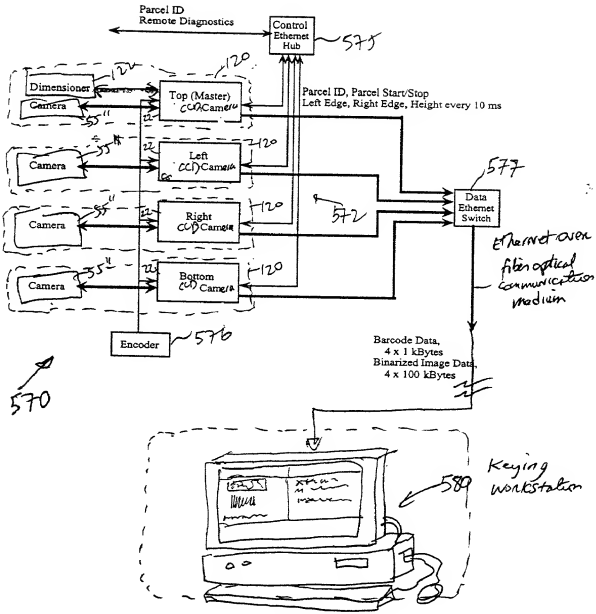
Parcel ID
Remote Diagnostics
Control
Ethernet
Hub
575
120
Dimensioner
Camera
Top (Master)
CCD Camera
Parcel ID, Parcel Start/Stop
Left Edge, Right Edge, Height every 10 ms
Camera
Left
CCD Camera
577
Data
Ethernet
Switch
572
Camera
Right
CCD Camera
Ethernet over
fiber optical
communication
medium
Camera
Bottom
CCD Camera
Encoder
576
Barcode Data,
4 x 1 kBytes
Binarized Image Data,
4 x 100 kBytes
570
Keying
Workstation
580

FIG. 29

TO92TT' 0ETE8860

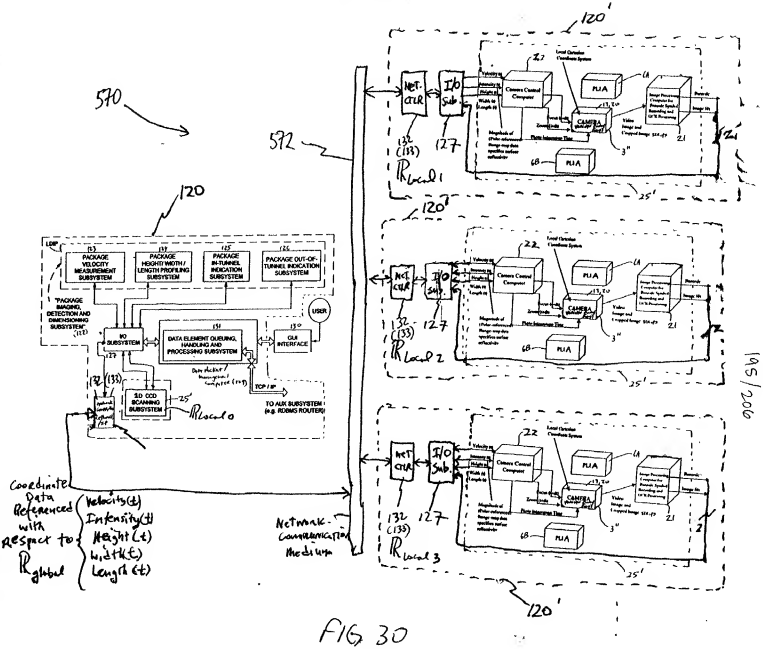

FIG 30

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TD92TT'0ETE886D

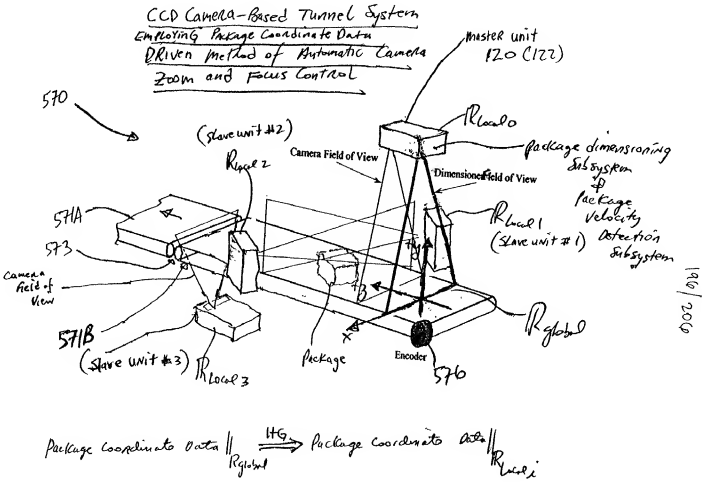


FIG. 31

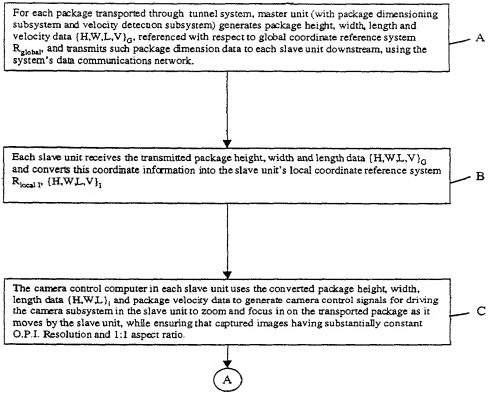

For each package transported through tunnel system, master unit (with package dimensioning subsystem and velocity detection subsystem) generates package height, width, length and velocity data $\{H,W,L,V\}_G$, referenced with respect to global coordinate reference system R_{global}, and transmits such package dimension data to each slave unit downstream, using the system's data communications network.
A
Each slave unit receives the transmitted package height, width and length data $\{H,W,L,V\}_G$ and converts this coordinate information into the slave unit's local coordinate reference system $R_{local\ 1}$: $\{H,W,L,V\}_1$
B
The camera control computer in each slave unit uses the converted package height, width, length data $\{H,W,L\}_1$ and package velocity data to generate camera control signals for driving the camera subsystem in the slave unit to zoom and focus in on the transported package as it moves by the slave unit, while ensuring that captured images having substantially constant O.P.I. Resolution and 1:1 aspect ratio.
C
A

FIG. 32A

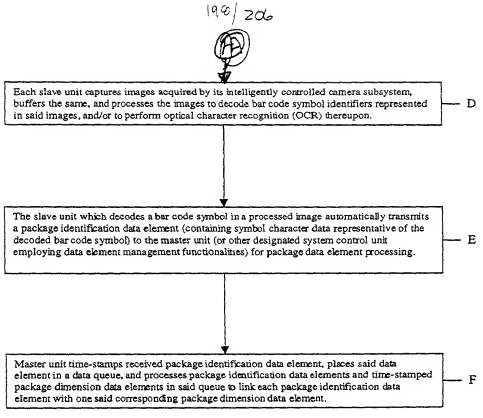

198/206
A
Each slave unit captures images acquired by its intelligently controlled camera subsystem, buffers the same, and processes the images to decode bar code symbol identifiers represented in said images, and/or to perform optical character recognition (OCR) thereupon.
D
The slave unit which decodes a bar code symbol in a processed image automatically transmits a package identification data element (containing symbol character data representative of the decoded bar code symbol) to the master unit (or other designated system control unit employing data element management functionalities) for package data element processing.
E
Master unit time-stamps received package identification data element, places said data element in a data queue, and processes package identification data elements and time-stamped package dimension data elements in said queue to link each package identification data element with one said corresponding package dimension data element.
F

FIG. 32B

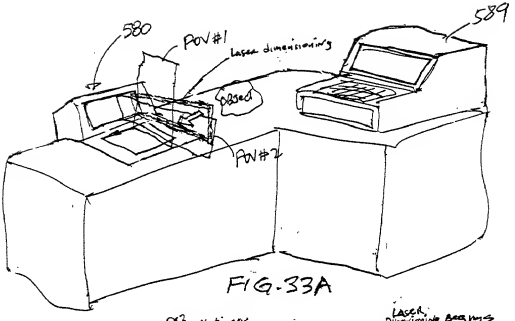


FIG. 33A

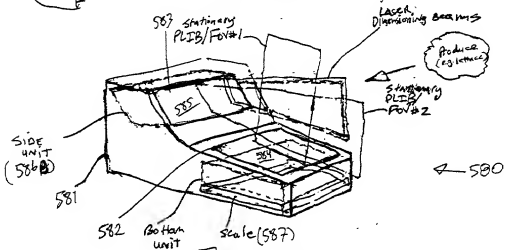
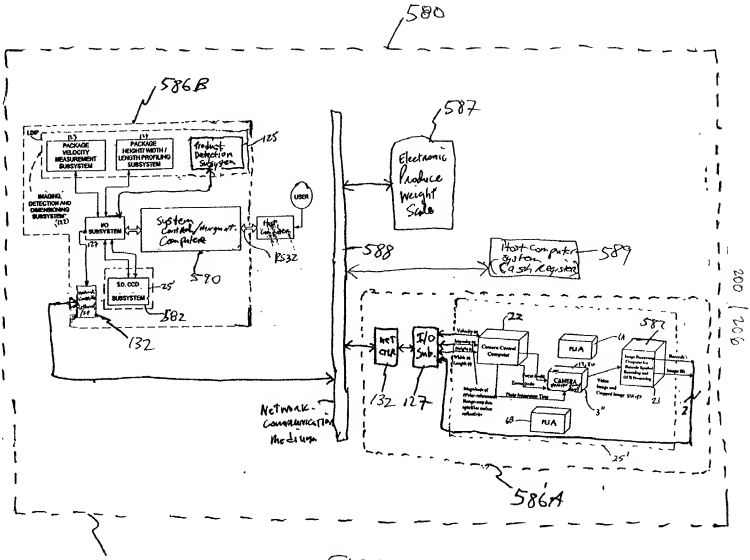


FIG. 33B

US 2006/0261157 A1



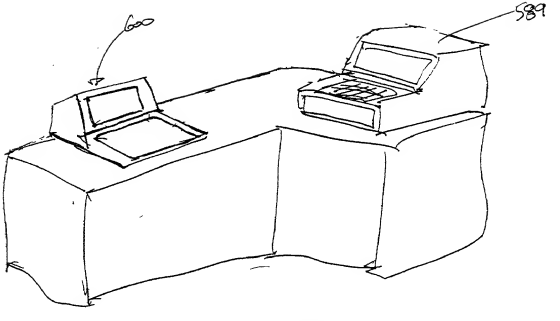


FIG. 34A

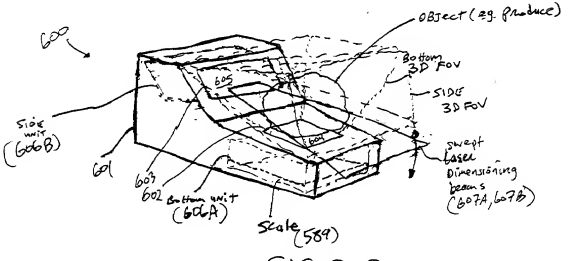


FIG. 34B

T0927T' 0CTE8860

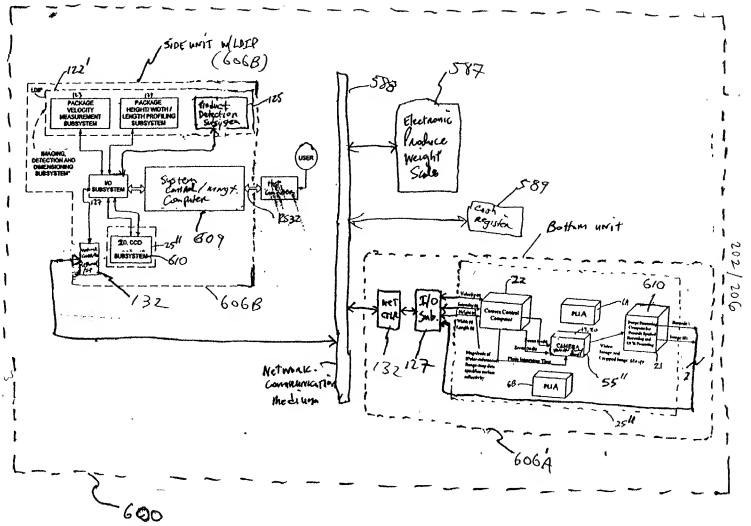


FIG. 34C

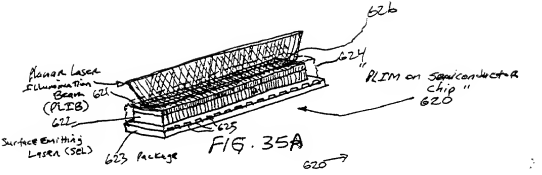


FIG. 35A

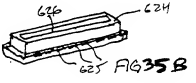
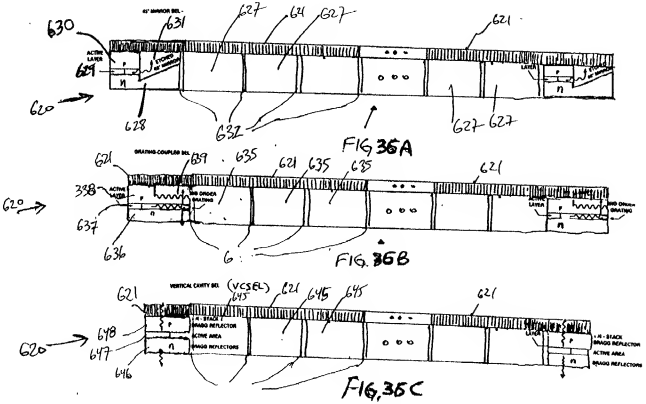


FIG 35B

TD9211 "DE19831860



SUBSTITUTE SHEET (RULE 26)

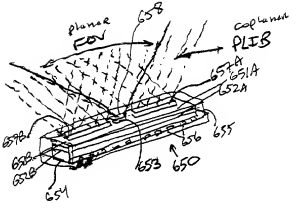


FIG. 37

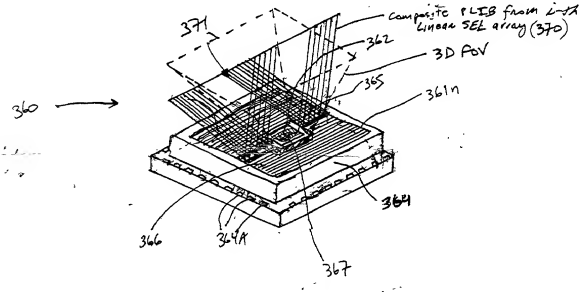


FIG. 38A

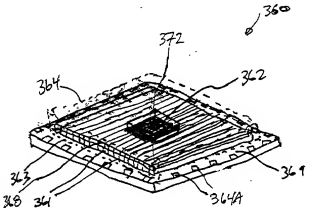


FIG. 38B